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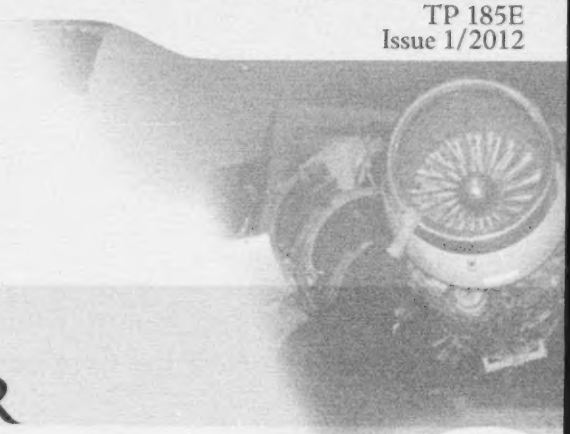

AVIATION SAFETY LETTER

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Learn from the mistakes of others;
you'll not live long enough to make them all yourself ...

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A Modern Approach to Civil Aviation Safety Oversight

Martin Eley

We in aviation can all be proud that Canada has one of the safest aviation systems in the world. During the last decade, we have seen a continuous decline in the accident rate. In fact, we recently saw the total number of accidents decline to the lowest recorded figure in 10 years. So how do we keep moving forward? How do we continue to improve upon a system that's already strong? How do we make sure accident rates stay low and how do we drive them even lower?

This translates to a call to action for Transport Canada Civil Aviation (TCCA) as the regulator. As air traffic increases, we need to modernize safety practices just to keep accident rates at current levels. TC identified this need several years ago, and at that time, to address exactly this challenge, TC committed to evolving the way it did business.

A move to systems-based safety management

Over the course of the last few years, TCCA has undergone a fundamental change in its approach, and in the industry you've surely noticed this change. Today, we're working differently than we did a few years ago and we're already seeing international recognition for the approach we are taking.

Safety Management Systems (SMS) mandates a reporting culture and also encourages employee feedback. Our inspectors conduct SMS assessments to verify that the SMS concept is working in practice, not just in theory. These inspections include numerous interviews with company employees and managers, which is something we have never done before. Results show that Canadians are indeed best served by this modern safety culture.

We continue to work hard every day to refine our practices and further advance an already exceptional air safety system. We are also collaborating with industry stakeholders and we are very pleased to see so many taking initiative, such as developing guidance material, to strive for the highest level of safety.

The move to a systems-based approach to safety has been no small task. SMS implementation for Canada's large airlines was a major undertaking and it took time to get things working effectively. While smaller operators may be less complicated, the sheer volume of them operating across the country is immense, which demands that we are fully ready before we begin SMS implementation for this sector of the aviation industry. It's very important to us to get it right, and I truly appreciate our stakeholders' understanding as we work to find the best way forward in modernizing aviation surveillance.

Internal quality assurance at Transport Canada

After seeing the benefits of applying a systems-based approach to the industry, we were confident that we here at TCCA could also benefit from this type of thinking. We began developing our own integrated management system (IMS), which is helping us put in place the right systems and processes to get things done more effectively and efficiently.

At its core, IMS is a quality management system. It involves documenting all of the policies, practices, procedures, and controls that guide and support the Civil Aviation Program, and it's allowing us to experience benefits similar to those achieved by the industry's safety management systems. Ultimately, this is about establishing consistency and effectiveness in our program's delivery across the country. This means the industry can expect to receive a consistent level of oversight from TC, whether its operations are based in Halifax, Whitehorse, or Victoria.

Reorganizing to serve Canadians better

Just as we're working to achieve efficiencies in the industry and in our own processes and procedures, we also want to be sure our organization is an efficient and effective one. In short, we're making sure we have the right people in the right places to meet TCCA's aviation safety oversight commitments. We're integrating TCCA's functions and being as cost effective and efficient as possible while staying true to our mandate of maintaining a high level of aviation safety in Canada.

The reorganization project is called the National Organization Transition Implementation Plan (NOTIP). The team leading this transition is close to realizing its goal of implementing the design of a modern organization that easily facilitates the application of TCCA's business model, the introduction of SMS, and the implementation of our own IMS. We're making every effort to recruit and retain employees that have crucial competencies, as well as maintaining corporate memory. What's more, the standard work descriptions being created by the transition team will provide consistency, which again means the industry can expect to receive a consistent, efficient oversight from TC across the country.

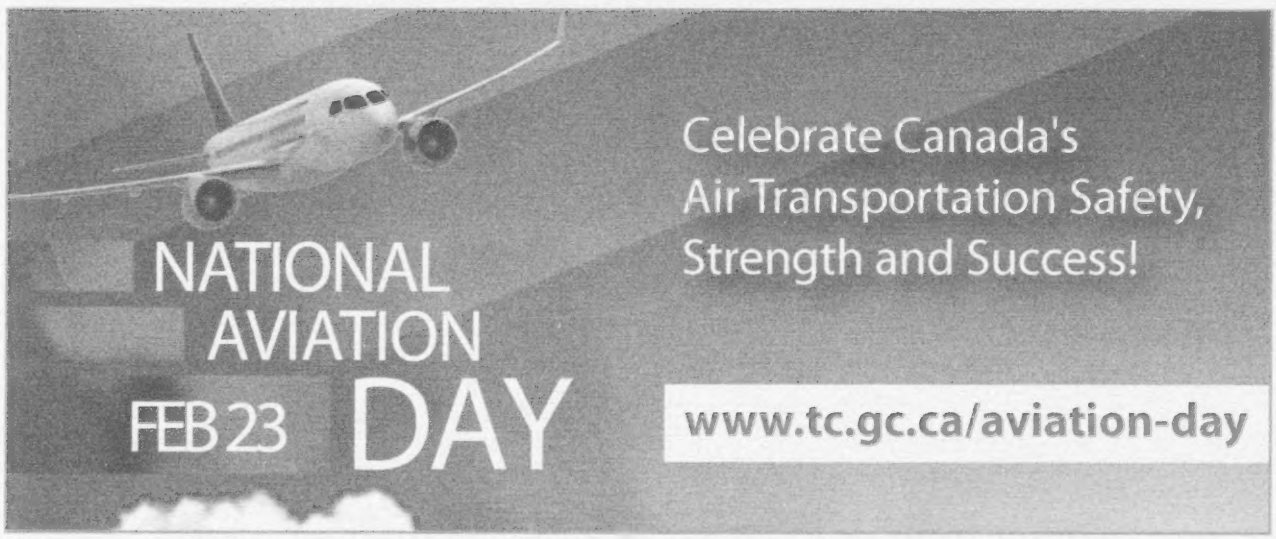
In closing

As Gerard McDonald, Assistant Deputy Minister of Safety and Security, stated in the previous issue's editorial, "Canada has one of the safest aviation systems in the world." He and I both feel this is something to be proud of and something to drive us forward to reach new goals. In the business of safety, we can never afford to become too comfortable or complacent, even when the level of safety is already high. We must always reach higher and ask ourselves, "how can we continue to improve," and "how can we make sure our system stays safe despite increasing volume?"

At TC, we are committed to driving the level of aviation safety even higher by modernizing the way we do things. By evolving our approach to safety oversight, re-evaluating our own policies and procedures, and reshaping our organization, we're confident we're ready to meet the challenges of the ever-developing aviation sector.

Be assured that we will continue to work with our industry partners to maintain the exceptional level of aviation safety Canadians already enjoy, as safety is a responsibility we all share.

Martin J. Eley
Director General
Transport Canada, Civil Aviation



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The SMS Approach to Dangerous Goods in a 705 World

by Daniel Sylvestre, Civil Aviation Safety Inspector, National Operations, Civil Aviation, Transport Canada

In 2005, the National Operations Branch, along with the rest of Civil Aviation, started the Safety Management System (SMS) certification of the air operators assigned to the Branch's Airlines Division, with final assessments completed in 2009. While there were massive efforts by both the air operators and Transport Canada (TC) to bring a successful completion to this new system, we cannot forget that day-to-day operations continued. The air operators continued to fly and TC continued with certification and surveillance activities, including activities related to the safe transport of dangerous goods by air.

As the transport of dangerous goods by air affects everybody in the air operators' activities, such as flight operations, cabin safety, passenger handling, ground handling, cargo operations and the shipments of maintenance spares, the oversight strategies often had to be customized. In addition, the safe transport of dangerous goods involves many laws and regulations, among them the *Civil Aviation Regulations* (CARs), the *Transportation of Dangerous Goods Act* (TDGA) and associated *Regulations* (TDGR), and by reference, the International Civil Aviation Organization's (ICAO) *Technical Instructions for the Safe Transport of Dangerous Goods by Air*.

To date, we have every indication that the implemented SMS strategies worked, allowing us to review the best practices that made it possible. We believe that one of the key ingredients to its success was that whenever a new process was initiated or developed, we returned to the SMS principles identified in TC's documents.

One of the key principles, and the cornerstone of the air operator's SMS, is the non-punitive reporting policy. An air operator must have a policy signed by the accountable executive that would prevent any reprisals against anyone who reports any error, omission or incident committed without malice or not while under the influence of drugs or alcohol. This results in the gathering of intelligence of what is really happening. In addition, with the air operator conducting an investigation, the root causes of the error, omission or incident can be identified, eliminated or mitigated to prevent the probability of a repeat.

The TDGR and ICAO's *Technical Instructions for the Safe Transport of Dangerous Goods by Air* require that an air operator reports various types of occurrences to the State of Authorities (TC) such as:

- dangerous goods incidents and accidents; and
- undeclared or mis-declared dangerous goods in cargo or passengers' baggage.

Using the same policy of "non-punitive reporting" required by the air operator's SMS, we have applied these principles in handling all the reports from air operators. When an air operator reports occurrences to TC, they must provide, within a 30-day time frame, the probable root cause(s), and short- and long-term corrective action plans and means to ensure that the corrective action plans are effective. To date, we have reviewed over 460 of these occurrences. Such a high number of reports demonstrates that the non-punitive reporting system works.

The collecting of this information has allowed us to:

- develop a database of occurrences and associated corrective action plans (CAP);
- develop a database of articles containing dangerous goods intercepted in passengers' or crew members' baggage;
- identify the current issues faced by the air operators;
- share with all air operators the best practices to improve safety; and
- develop proposals to revise and improve the TDGR.

Naturally, whenever material is shared with all air operators, ICAO's *Code of Conduct on the Sharing and Use of Safety Information* is followed and any information, such as the identity of the air operators, is removed to prevent a misuse of the information.

The intelligence obtained has been quite important in improving domestic and international regulations. Since 2004, National Operations, Airlines Division has been providing a technical advisor to the member representing Canada at the ICAO Dangerous Goods Panel (DGP). Issues or difficulties identified through the occurrences reported by the air operators are then converted into working papers proposing revision to the TDGR. We have been successful in the approval of many proposals

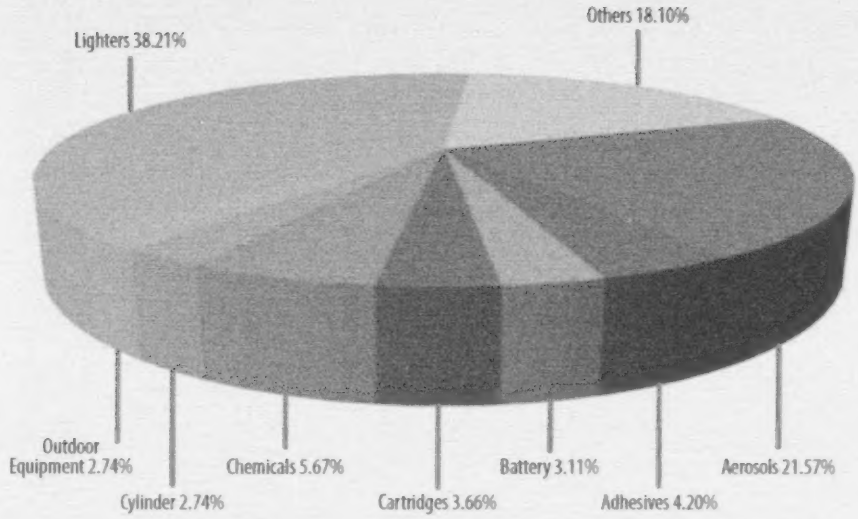

Figure 1: Proportion of dangerous goods in articles intercepted in passenger or crew baggage in the last 12 months

and the implementation of many changes to international regulations, including:

- the requirement that hidden dangerous goods notices contain pictograms for foreign speakers;
- an authorization to carry onboard life-saving devices such as automated external defibrillators (AED), nebulizer, and continuous positive airway pressure (CPAP) containing large lithium batteries; and
- a reformatting of the list of articles containing dangerous goods in a table format to simplify information retrieval.

The analysis of the data has also allowed us to identify where the surveillance activities must be concentrated. Changes have also been made to the oversight activities. When performing a process inspection at an airport, the air operator's dangerous goods coordinators are invited to participate. By performing such joint activities, we are able to share knowledge, discuss issues and develop possible corrective options when non-compliances are observed. When a finding is issued, it is against the air operator's system for not discovering the non-compliance.

In order to assist air operators, on a monthly basis, the Branch publishes and communicates to all the dangerous goods coordinators of an air operator, a dangerous goods profile that lists all the contact information, air operator's variations, approved training programs and publications, and all the expected corrective action plan(s) and their due dates. In addition, the Branch provides a list of all the latest revisions to regulatory and non-regulatory publications.

This successful approach has been shared with other states, through the assistance of TC's International Operations, by providing training to dangerous goods inspectors from other civil aviation authorities including Bahamas, Bangladesh, Cambodia, China, Fiji, Hong Kong, Indonesia, Laos, Macao, Mongolia, Philippines, Seychelles, Singapore, South Korea, Sri Lanka, Thailand and Vietnam.

Safety management principles can be applied to any activity to reduce the risk associated with that activity. The application of SMS principles in the oversight of dangerous goods has proven to be a success story that is sure to be repeated in other sectors as well. As we continue to move forward, it is the culture change and knowledge that will facilitate the successful implementation of SMS. △

Invest a few minutes into your safe return home this winter...

...by reviewing section RAC 2.7 of the *Transport Canada Aeronautical Information Manual* (TC AIM), titled "**Low Level Controlled Airspace.**"

COPA Corner---Electrical Fires Do Happen

by Dale Nielsen. This article was originally published in the "Chock to Chock" column of the February 2010 issue of COPA Flight, *and is reprinted with permission.*

Smoke in the cockpit could be the result of an electrical fire. The acrid smell of an electrical fire is very distinctive, but any smoke from the area of the instrument panel, circuit breaker panel or any panel with a number of electrical switches should be considered an electrical fire. An electrical fire is a critical emergency.

The Cessna 172 was on a local VFR flight when the pilot squawked 7700 and returned for landing. After landing, the pilot reported smoke in the cockpit and a radio failure.

An RV 7 pilot saw sparks and smoke coming from under the instrument panel. He declared an emergency, shut down the electrical system and returned for landing. After landing, there were no longer any sparks coming from under the instrument panel and the smoke had dissipated. An inspection revealed that a hose clamp had come loose, allowing a metal hose ducting in air from the outside to come in contact with a fuse bus, causing a short.

A Cessna 172R was on a local training flight when the crew noticed smoke and fumes in the cockpit. They declared an emergency, shut down all electrical systems and returned for landing. An inspection by an AME revealed a faulty landing light switch.

An instructor and student in a Cessna 152 were leaving the control zone on a local training flight when both began to smell smoke and noticed a light haze in the cockpit. The instructor then noticed the radio lights begin to flicker. He received a slight electrical shock when he attempted to select the radio to "Off". The Battery Master Switch was selected "Off" and the smoke dissipated rapidly. The instructor then used his cell phone to get clearance to return to the airport and land. He did not declare an emergency. The tower controller did however contact the airport emergency services to stand by. Maintenance personnel discovered that the starter bendix had not disengaged after engine start. The overheated starter caused the aircraft electrical system to overheat, causing the smoke and haze.

Ten minutes after departing from the airport, the Cessna 172 cockpit filled with smoke. The pilot turned the Battery Master Switch "Off" and used his cell phone to declare an emergency and to get clearance to return to the airport for landing. During the return, the pilot reported that the smoke had dissipated, but wanted his emergency status to remain in effect. A maintenance inspection revealed a short from a bare wire.

In the first incident, we don't know from the report if the pilot shut down his electrical system. All of the other pilots did. From previous aircraft incident/accident reports, we know that people may become incapacitated by electrical smoke in less than 3 minutes. Electrical smoke is toxic. It is imperative to turn the Master Switch "Off" immediately when electrical smoke is detected or suspected.

All of the pilots declared an emergency, either verbally or with the transponder, except the C–152 instructor, and he should have. Fortunately, the tower controller did it for him. You may not know it, but you may be partially incapacitated.

The electrical fire checklist in most aircraft read as follows:

- Turn off the battery/alternator master switches.
- Don an oxygen mask if one is available.
- Turn off all electrical switches.
- If the smoke or fire persists, use the fire extinguisher, then ventilate the cabin.
- Essential electrics can be selected back on one at a time, while watching for a re-occurrence of the smoke or fire.

"Essential" is a key word here. After an electrical fire, only select "On" those electrical services that are essential for getting the aircraft to the nearest airport. Be prepared to re-select a service back "Off" immediately if the smoke or fire returns.

Troubleshooting to find the source of the fire must be left for the maintenance people with fire trucks standing by, especially if we have used up our one-shot fire extinguisher.

What is essential in an aircraft in VFR conditions? Nothing. The engine will run perfectly well without any electrical services. We can continue to our destination or to an alternate uncontrolled airport and complete a NORDO procedure. If we have a cell phone on board, we can use it to get clearances for control zone entry and for landing as did two of the pilots mentioned above.

In IFR conditions, we may require a radio or navigation aid. We must only turn on what we absolutely require, and then only after some thought as to where the smoke may have come from, and after checking for popped circuit breakers.

Damage caused by fire in the cockpit of a King Air 100.
Photo : www.pitop.org

Pilots employed in commercial operations are now required to annually review the use of circuit breakers as the result of electrical fires that have occurred when pilots repeatedly pushed in popped circuit breakers. The Transport Canada (TC) recommendation and the industry policy is if the electrical system protected by the popped circuit breaker is not necessary for the remainder of the flight, it is not to be reset. If the system is considered to be necessary, one reset is permitted. The breaker is not to be reset if it pops again.

The incidents described above occurred in 2009. Electrical fires do happen. As we can see, following correct procedure will get us home safely in the event we encounter an electrical fire or smoke. Fly safely.

Dale Nielsen is an ex-Armed Forces pilot and aerial photography pilot. He lives in Abbotsford, B.C., and currently flies MEDEVACs from Victoria in a Lear 25. Nielsen is also the author of seven flight training manuals published by Canuck West Holdings. Dale can be contacted via e-mail: dale@flighttrainingmanuals.com.
To know more about COPA, visit www.copanational.org. △

Emergency? Let Air Traffic Services Know

by the Safety Management Planning and Analysis Division, NAV CANADA

Recent discussion in aviation safety forums and with the pilot community suggests that some pilots may not understand the importance of letting air traffic services (ATS) know when they are concerned about the safety of their flight.

What's an emergency?
There are many different reasons why a pilot may be concerned with safety. Some of these may sound familiar:

- you have mechanical problems or malfunctioning avionics;
- you're concerned about low fuel;
- while you are flying VFR, the cloud bases come down and you're forced to climb through an overcast layer in order to reach VFR over-the-top conditions;
- you're a VFR pilot flying above scattered cloud conditions that unexpectedly change to overcast, without time for you to descend;
- yourself or a passenger become ill in-flight; or
- you're lost.

NAV CANADA air traffic controllers and flight service specialists provide assistance to pilots in these types of situations. But we need to know that you are experiencing an emergency!

What does a controller or flight service specialist do when a pilot issues a Mayday or a Pan Pan?
The word "MAYDAY" spoken at the start of communication identifies a distress message that indicates that the aircraft is threatened by serious and/or imminent danger and requires immediate assistance.

The words "PAN PAN" identify an urgency message concerning the safety of an aircraft or other vehicle, or some person on board or within sight, which does not require immediate assistance.

Timely notification of ATS personnel about an emergency or potential issue that may impact flight safety is critical. Once a controller or specialist is made aware, there are a number of different actions that they may take depending on the nature of the situation:

- Priority of service
  - Given that they are aware that a situation exists, ATS personnel can better prioritize the level of assistance that may be required, offering direct routes or assistance in planning for alternate destinations.
- Coordination with other ATS units
  - A flight service station (FSS) or control tower may contact the area control centre for radar

assistance or to coordinate between IFR and VFR aircraft (special VFR authorization).
  - Controllers may coordinate the use of additional airspace, protecting emergency climbs or descents by blocking altitudes or diverting other traffic as necessary.
- Notifying outside agencies
  - Relaying information to a company dispatch or maintenance may yield assistance to the pilot or flight crew in resolving in-flight issues.
- Notifying emergency services
  - ATS personnel will do this either directly with local emergency services or through the destination unit, keeping in mind that in many smaller locations, emergency services are not on site, therefore increasing response times.

Failure to notify ATS about an emergency or potential problem may result in a delay in having the appropriate responders available. If you're in doubt about the safety of your flight, let ATS know as soon as possible. You can always cancel later.

ICAO proposed changes

Finally, the International Civil Aviation Organization (ICAO) is proposing amendments to Annex 6 and PANS-ATM regarding fuel management for implementation on November 15, 2012. These changes include the introduction of new fuel-related terms and phraseology that differentiate MINIMUM FUEL from a FUEL EMERGENCY. It is expected that Canada will comply with the amendment. An appropriate notification will be forthcoming as well as amendments to ICAO and Canadian publications once the changes are finalized.

EMERGENCY COMMUNICATIONS

As soon as there is any doubt as to the safe conduct of a flight, immediately request assistance from ATC. Flight crews should declare the situation early; it can always be cancelled.

- A distress call (situation where the aircraft requires immediate assistance) is prefixed: MAYDAY, MAYDAY, MAYDAY.
- An urgency message (situation not requiring immediate assistance) is prefixed: PAN PAN, PAN PAN, PAN PAN.
- Make the initial call on the frequency in use, but if that is not possible, squawk 7700 and call on 121.5. (Note: 121.5 is not available or monitored via PAL or RCO facilities. Only tower and FSS personnel monitor 121.5 during hours of operation.)
- The distress/urgency message should contain (at a minimum) the name of the station addressed, the call sign, nature of the emergency, fuel endurance, persons on board and any supporting information such as position, altitude (climbing/descending), speed, heading and pilot's intentions.

Minimum fuel advisory

As per the TC AIM (RAC 1.8.2), pilots may experience situations in which delays caused by traffic, weather or any other reason result in the pilot being concerned about the aircraft's fuel state upon reaching destination. In such cases, the pilot may declare to ATC that a MINIMUM FUEL condition exists. This declaration results in ATC taking specific actions as per RAC 1.8.2 and alerts them that an emergency situation could develop.

'Fuel emergency' and 'fuel priority' are not recognized terms. On reaching an emergency situation with respect to the aircraft's fuel state, flight crews should declare a PAN or MAYDAY to be sure of being given the appropriate priority. △

Worthwhile Reading: The 1999 Transport Canada Evaluation of Stall/Spin Accidents in Canada ..... page 10
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Worthwhile Reading: The 1999 Transport Canada Evaluation of Stall/Spin Accidents in Canada

by the Standards Branch, Civil Aviation, Transport Canada

The following article is from the 1999 Transport Canada (TC) evaluation of stall/spin accidents (TP 13748E), which had been prepared by human factors specialist Jim McMenemy, and Civil Aviation Inspector Brian Penner. This research was done to guide decision-makers regarding whether or not TC should keep spin recovery as part of the private pilot flight test. This study was referred by the Transportation Safety Board of Canada (TSB) in their Final Report A02O0287, relating to an accident on September 7, 2002, involving a Cessna 172 in an attempt for the "impossible" 180° turn back to the runway (a lake in that case). This accident was featured in Aviation Safety Letter *Issue 1/2005. This study was also instrumental in developing* Stall/Spin Awareness–Guidance Notes–Private and Commercial Pilot Training *(TP 13747E), which are found on our Web site to this day. While we certainly encourage readers to revisit the documents referred above, we publish here the analysis that preceded them. We feel this professional research is not only informative and practical reading for all pilots, but that it also deserves to be shared. It should also provide context and arguments for those of you who debate the 180° turn back to the runway in the event of an engine failure after takeoff. —Ed.*

An Evaluation of Stall/Spin Accidents in Canada (TP 13748E, 1999)

Canada is the last major aviation country to test spins on the private pilot flight test. The spin hasn't been required in primary training in the United States since 1949. It is not required in the JAA standard adopted in Europe, nor is it required in private pilot training in either Australia or New Zealand.

Other aviation authorities have moved to a model of stall/spin awareness in the hope of focusing the training on recognition of situations that could lead to an inadvertent stall and spin. In addition to the fact that Canada's major aviation partners do not include the spin in either training or testing for the private pilot licence (or, for that matter, the commercial pilot licence), it is becoming increasingly difficult to obtain new aircraft that are certified for spins.

To support flight training development and be sure that Canada was moving in the right direction, it was decided to examine the safety record related to stall and spin accidents in general aviation aircraft in Canada. This evaluation, which reviews Canadian stall/spin accidents over the last ten years, was launched in the hope that it would help everyone understand the reality of these accidents and determine whether changes to training may be effective in advancing safety.

One fact that emerges clearly in this study is this: "One feature that stands out in all except one of the 39 stall/spin accidents examined is that knowing how to recover from the stall or spin was of no benefit to the pilots in these circumstances. They stalled at altitudes so low, that once the stall developed, a serious accident was in progress. Safety will be advanced therefore by preventing stalls and spins."

To some degree, the way spins are taught in the current syllabus may even create risk by fostering the illusion that real spins are typically entered from a classic, power-off clean stall and, for some aircraft, a lot of effort is needed to initiate and maintain the spin. However, such apparently docile aircraft spin quite differently when fully loaded, when they are operated outside the utility category, and in the real world the spins that kill tend to be entered at low altitude and in situations that don't resemble the classic clean stall and don't give enough room to recover. Some occur when speed is allowed to decay on approach and when a cross-control situation develops. Some occur when full power has been applied in an overshoot. Some occur in an attempt to turn back to the airport when the engine fails immediately after takeoff. In these situations, the development of the spin is sudden and aggressive, unlike anything the pilot might have seen in training.

If the Canadian approach to spin training and testing has left us with a continuing concern about the numbers of fatal stall/spin accidents, would we do better with a stall/spin awareness model? In the United States, where stall/spin awareness has been used for years, spins still account for roughly 12 percent of general aviation accidents and 25 percent of the fatal accidents. In Canada, the stall/spin accident rate is not appreciably different from the American experience. Ten years ago, the spin-related accident rates in Canada varied from a low of 0.8% to a high of 2.4% whereas in the United States the rate varied from a low of 1.3% to a high of 2.4% (TSB, 1987).

Comparison of different statistical environments is always difficult—Canada and the United States count and define

things differently—but there is not a significant difference in the stall/spin accident rate between the two countries. Canada is not gaining an obvious safety dividend from the current approach to spin training and testing.

This 2006 crash was a case of mishandling of the aircraft, resulting in an aerodynamic stall, followed by a spin.

Method

The first step was to identify the accidents relevant to the question at hand. A key word search was conducted on the TSB database to identify stall and spin accidents over the past ten years in Canada. A total of 39 stall/spin accidents involving single-engine or light twin-certified aircraft were identified. TSB occurrence reports and occurrence briefs were obtained.

There is a tendency to consider accidents to be events. They are events, often tragic events, but, if your goal is accident prevention, accidents are better understood as processes, the results of a series of events, conditions, and human actions/decisions with decidedly negative outcomes. Understanding the processes that lead to accidents and incidents is a vital step in identifying changes that will prevent or mitigate the negative outcomes. To arrive at a common understanding of the factors that lead to accidents, it was important to apply a standardized approach to analyzing occurrences to identify the causal and contributing factors for each occurrence reliably and accurately.

The Civil Aviation Human Error Model and its companion analytic process were used to analyze the accidents. The aim is to identify and analyze the unsafe acts and unsafe conditions which contributed to the accident. When the factors that lead to unsafe acts or errors are understood, it is possible to identify interventions which have the potential to reduce the number or severity of accidents.

Results

The Civil Aviation Human Performance/Human Error model was used to analyze each occurrence. In every case at least one unsafe act or error was identified. In some cases the background data were not sufficient to support a complete analysis and identify the antecedents or contributing factors. In most cases, however, the model helped understand the accident and identify factors that contributed to the mishap.

The occurrences broke down into three principal groups:

a. stall or spin accidents resulting from aircraft handling (27);

b. stalls or spins following engine failure (9); and

c. stalls or spins resulting from loss of control in IMC (3).

Handling Accidents

Twenty-seven accidents resulted from mishandling the aircraft into an aerodynamic stall. These accidents resulted in 26 fatalities and 16 serious injuries. In two cases, it appears that the engine was not producing full power but the aircraft was capable of controlled flight and the stall was avoidable. In all cases, the stall, which sometimes precipitated a spin or wing drop, occurred at low altitude and at low airspeed. The stalls and spins occurred at a height where recovery was very difficult and probably impossible. Sixteen stalls resulted from turning at low airspeed, 10 occurred in straight ahead flight, and one inverted spin developed when the pilot was practising aerobatics at about 1 500 ft AGL.

Most of the 27 handling accidents happened during the takeoff/initial climb-out or approach phase. There were 13 stalls during the climb-out after taking off and at least six of these occurred during a low speed, low altitude turn. Five stalls, all in turns, occurred during the approach/landing phase, most often on turning base to final. One practice overshoot ended in a stall when the instructor waited too long to take control and the airspeed fell too low.

Three of the en route accidents occurred in mountainous terrain. A navigational error led to a very difficult situation in one of them. Better mountain flying technique might have prevented all three accidents. At the moment of impact, damage and injury might have been reduced if the aircraft had been under control rather than stalled. Two pilots were flying while intoxicated. One spin occurred during acrobatic practice. The spin occurred at about 1 500 ft and using the approved recovery technique might have prevented or reduced the severity of the accident. One accident happened when an unqualified instructor was teaching slow flight below the

manufacturer's recommended altitude and did not apply the correct recovery procedure.

Several seaplane pilots made what are, in retrospect, obvious planning errors by taking off toward rising terrain with insufficient room to clear terrain or not accounting for downdraft conditions when taking off from steep banked lakes. These errors are obvious now, but probably were not apparent to the pilots involved until it was too late. Contributing factors include human visual limitations. People are not able to judge absolute distances. This makes judging how far away an obstacle is very difficult, especially when the field of vision is flat and featureless, like a body of water. It is possible that some pilots, due to perceptual limitations misjudged the distance available and did not recognize the problem until it was too late. Downdraft occurring as the aircraft approached a shoreline and drift illusion appear to have taken three pilots by surprise. Lack of awareness and not being prepared to cope with the effect led to stalls and crashes.

Two float-equipped aircraft stalled and crashed when the pilots undertook instructional or check flights with no rear seat control column installed. The instructor/check pilot was, therefore, unable to exert any control when the front seat pilot mishandled the aircraft.

In some cases, heavy, possibly even overweight aircraft may have contributed as well. Lack of experience flying aircraft near, or at, maximum gross weight, in one case with an external load, may have led to the pilots being surprised at the effect that fuel weight and loads had on aircraft performance. The importance of weight and balance calculations was emphasized by the fact that at least one aircraft was flown with the centre of gravity aft of the design limit.

Currency, supervisory factors and the importance of developing and ensuring compliance with standard operating procedures were all identified as contributory factors. The young glider tow plane pilot who took an unauthorized passenger, flew a low pass over the field, and stalled in a steep climbing turn was in violation of several rules. Standard operating procedures can contribute consistency, but in commercial operations those with supervisory responsibilities must be vigilant in promoting compliance.

Several of the pilots who mishandled their way into stalls were not current on their aircraft. One private pilot, demonstrating his aircraft to a potential purchaser, had flown only ten hr in the previous 12 months. He climbed out too steeply after takeoff, airspeed decayed and the aircraft stalled. Several other private pilots were either low time pilots, flew infrequently, or both. Skill decay is likely to affect such pilots if any unusual circumstances requiring quick assessment of the situation and rapid accurate decisions should arise.

Accidents following engine failure

Nine accidents resulted from stalls/spins following engine failures. Two of the aircraft were twins and the rest were single-engine. Preventing engine failure is the best way to reduce this type of accident and several of the engine failures could have been prevented. Losing power, however, is not always preventable. It is a critical emergency and effective management of the situation is essential to achieve the best possible outcome.

Poor maintenance, fuel contamination, and taking off with insufficient fuel led to preventable engine failures. In one case, a pilot had a rough running engine. He landed, removed the engine winterizing kit, and tried to conduct a test flight. The engine failed shortly after takeoff. One engine failure resulted from using contaminated fuel. The pilot in that instance continued the flight after two partial power losses. Two pilots took off with so little fuel on board that the engine stopped on climb-out. Another crash was traced to poor maintenance.

An accident may be inevitable after an engine failure but the task of the pilot is to minimize personal injury and damage to the aircraft. Losing control of the aircraft is the worst possible outcome after losing power.

Regardless of the fact that some of the engine failures were preventable, inadequately coping with the situation is an even more serious failure. All of the engine failures occurred at low altitude so that recovery from a stall or spin was impossible. It is vital therefore, in such situations that control be maintained and the aircraft not stall. All nine stalls/spins resulted from mishandling the aircraft in an emergency and most of the problems can be traced to poor decisions. At least eight out of these nine did not follow approved procedures. Deviations include basic items such as failing to raise the landing gear and not flying recommended airspeed. Five pilots stalled after turning back to the runway following an engine failure after takeoff.

Loss of control in instrument meteorological conditions (IMC)

Three accidents resulted from loss of control in IMC. In one case the pilot, after being warned about the weather, still went flying and, in fact lost control of the aircraft three times and recovered, but continued the flight. He apparently did not recover the fourth time and perished. This is the only stall accident examined which involved a high altitude stall. Another pilot had made several

attempts over a period of days to deliver his passengers but was prevented by weather. Pressure to complete the job and a forecast of improving conditions at destination may have lured him into the attempt. The aircraft stalled and spun to the earth from tree top height resulting in three serious injuries. The final accident also involved passengers. The aircraft stalled at very low height. Weather information may have been lacking as the nearest observation site was 60 miles away.

Discussion

One feature that stands out in all except one of the 39 stall/spin accidents examined is that knowing how to recover from the stall or spin was of no benefit to the pilots in these circumstances. They stalled at attitudes so low that once the stall developed, a serious accident was in progress. Safety will be advanced therefore by preventing stalls and spins. In this section of the paper we will continue the analysis of the unsafe acts which caused or exacerbated the accidents and begin the task of identifying potential countermeasures which could be implemented in training and flight testing.

Currency and skill decay

Different types of skills, once learned and not practised for periods of time, will degrade at different rates. Continuous movement skills, such as steering, guiding or tracking are relatively impervious to decay. Decision making, recalling bodies of knowledge and skill at tasks which require verbal communication between people, however, are subject to fairly rapid decay if not practised.[1] A measurable skill decrement at information processing and communication tasks can be apparent in a couple weeks if the skills are not practised.

The pilot who has not flown for a period of several weeks or months could be misled in certain situations. Such a pilot might expect that there has been some degradation in skill, but once in the aircraft, find that the stick and rudder skills are fairly intact. During a routine flight, there might not be much demand for problem solving and the pilot might conclude that no serious skill decay has occurred. In fact, the skill decay is hidden and may not become apparent until the pilot is faced with an emergency or complex situation.

To preclude this, infrequent fliers should engage in a periodic review or refresher activity to ensure that the relevant knowledge is available for recall and the information processing and decision-making skills stay sharp.

Aircraft handling

Aircraft handling is a psychomotor skill involving both mental and physical components. The mental skills involve information processing and decision making while the physical skills involve eye-hand-foot coordination, and aircraft extensive practice, the control skills can become so well learned that the normal adjustments that are required to maintain or change attitude or direction can be accomplished without conscious thought. This does not imply a lack of attention, but is, in fact, a very efficient and effective way of handling well-learned, often complex tasks.

"During a routine flight, there might not be much demand for problem solving and the pilot might conclude that no serious skill decay has occurred. In fact, the skill decay is hidden and may not become apparent until the pilot is faced with an emergency or complex situation."

Departures from the normal, well-practised routines involve a greater degree of conscious cognitive activity. Most of the situations a qualified pilot encounters are resolved at the rule-based level of performance. The most important factor in arriving at the correct action is accurate recognition of the situation. Exposure to situations teaches us to recognize similar conditions when we encounter them again. Training teaches us how to deal with those situations. Repeated practice allows us to incorporate the required action into a routine which can be accomplished, virtually on automatic, without consciously thinking through all the steps.

Examination of the stall/spin accidents leads us to conclude that a significant number of pilots failed to recognize the symptoms of a developing aerodynamic stall. This is based on an assumption that no one would willingly enter a stall at a height which precludes recovery. It is possible, in some cases, to identify potential distractors which, by occupying the pilot's attention, may have prevented recognition of the developing stall. In other cases, it is likely that one or more aspects of the situation were not familiar. Since the pilot had never seen such a situation, he/she did not recognize the condition or the solution.

Stall and spin training for the private pilot's licence (PPL) begins with briefings and discussions on the ground so that the student pilot understands what is happening and how to deal with it. In the air the aircraft is stalled, typically straight ahead with power off. The stalls that led to the accidents were not entered that way. Most of

1 Rullo, JoAnn C.; McDonald, L. Bruce. *Factors Related to Skill Degradation and Their Implications for Refresher Training.* Paper presented to the 34th Annual Meeting of the Human Factors Society. 1990.

the stalls leading to accidents occurred at low altitude, taking off or landing when airspeed is significantly less than cruise. If a pilot's experience does not go beyond the basic straight-ahead, power-off stall and spins, it is very possible that the pilot will not recognize the situation and therefore will not take action in time to prevent the full stall.

Every pilot needs to know how to recover from a stall, but the accident record indicates that there are instances where recovery is impossible. Therefore, in these circumstances, early recognition and stall avoidance is even more important than being able to recover. To maximize the likelihood that a pilot will recognize the symptoms of a stall in other than straight-ahead, power-off conditions, student pilots should be exposed to the variety of stall initiation possibilities. They should learn to recognize the flight conditions that make stalls most likely and to take appropriate action to avoid the stall. To ensure that pilots can recognize the hazard and avoid the stall, the skills should be evaluated in the private pilot flight test. They must also learn that if a crash is inevitable, a controlled collision with terrain is far preferable to a stall or spin.

Coping with emergencies

There are two types of skills which are both of critical importance when coping with emergencies: cognitive skills and motor skills. The cognitive skills are the mental activities relating to assessing the situation and selecting or developing the plan or course of action. The motor skills relate to controlling the aircraft to accomplish the plan. The brain is a single-channel processor. This means that people can only consciously solve one problem at a time. If the motor or aircraft control skills are well learned, to the point that a pilot can perform them automatically, without conscious thought, then decision-making capacity is not being used on aircraft control tasks. This capacity is then available for assessing the situation, monitoring progress towards the goal, problem solving, or communicating.

In an emergency situation, such as an engine failure, acute stress will have predictable physiological and behavioural effects. Heartbeat and respiration rate increase. Attention often narrows down to one or two apparently salient features of the situation. This narrowing of attention often leads to problems because so much attention is devoted to one aspect of a situation that other important features, such as decaying airspeed, are not noticed. The normal scan of the instruments and the environment will become more rapid, but more superficial. People become susceptible to particular kinds of error at times of acute stress.

Historically, the forced landing is the most difficult exercise on PPL flight tests. This is understandable because it is a complex exercise and the situation, even in a practice environment, is inherently stressful. Although the requirement to perform a forced landing occurs rarely, the consequences of inadequate performance are dire and it is illogical to conclude that after the granting of a licence, skill at the task will improve, or even be maintained without practice.

Three measures are worth consideration to improve performance in forced landing situations. The first is to examine the task to identify all the component skills and practise each of these in isolation until proficiency is achieved. Then, the individual skills can be integrated. This approach is often used by flight instructors, but perhaps the practice could be improved by redefining the component skills and specifying the level of proficiency required before integrating the components. The second measure is to practise the skills often, both before and after earning a licence. Forced landing skills would be an ideal candidate for inclusion in a periodic review, should such an initiative be adopted. Thirdly, to ensure that the student is aware of the stall hazard and appropriate preventive measures during forced landing, stall/spin recognition training must include situations, such as descending turn stalls, than can be encountered during forced landings.

Take-off planning on floats

A number of float-equipped aircraft stalled during the climb-out after taking off because the pilot had selected a take-off route which was inadequate for the conditions. The human visual system is not capable of judging absolute distances. Seaplane training should include information on how susceptible we are to misjudging distances and techniques to ensure the adequacy of a take-off area.

Effects of weight and balance

Typically in flight training the aircraft will carry no more than the student, an instructor, and fuel. The student pilot learns about weight and balance, but learning about it and the experience of flying a heavy aircraft may be very different. It may be advisable for pilots to actually experience flying and manoeuvring an aircraft at or near its maximum gross weight in controlled conditions. Having had the experience, a pilot may be more able to recognize the change in handling characteristics and avoid stall conditions.

Turn back after takeoff

Several stalls occurred when the pilot decided to turn back to the runway when the engine failed. Typically, guidance on this topic recommends that the pilot land

straight ahead unless the aircraft has enough altitude to make the turn back to the runway. This constitutes a "fuzzy rule". That is, the rule requires interpretation, but the rule provides little or no guidance in making that interpretation. How much altitude is enough? Is it always the same? What variables may affect the requirement? The pilot is better off not having to consider these questions. Lives would be saved if the guidance required no thought or assessment. If an engine failure after takeoff results in an accident, the pilot is at least eight times more likely to be killed or seriously injured turning back than landing straight ahead. The easiest decisions to make are those which are prescriptive. As soon as the situation is known to exist, the procedure to follow is defined. Engine failure after takeoff should be such a decision.

Drift illusion

All pilots learn about drift illusion, but without experience, it is difficult to understand how compelling an illusion can be. Exposing the students to drift illusion so that they can learn to recognize and cope with it is difficult and potentially dangerous. Simulation may be an effective and safe alternative for teaching about drift illusion. Consideration should be given to developing better ways to teach student pilots about illusions.

EXECUTIVE SUMMARY

Pilots must be taught to recognize and recover from the onset of a stall/spin situation. Prevention must be the aim and the key to prevention is recognition. Skill in recovery from stalls is needed, especially stalls in those situations that lead to a wing drop and autorotation requiring immediate, precise, and confident handling. Once the spin develops, as this study shows, the situation is too often an accident in progress.

Canada's insistence that we continue to include spins on the private pilot flight test, including assessing the ability to ENTER a spin, has not given us a safety benefit over other countries that have moved away from this requirement. Results of instructor flight tests, and flights with instructors conducted on refresher courses in the past, tell us that some instructors may not be skilled at teaching the advanced stalls that will prepare pilots to recognize the onset of a stall/spin situation.

We have to bring the skill level of ALL instructors to the point where they can confidently show their students, at altitude, how mishandling during events such as a forced landing, a turn to final approach, an overshoot, or attempting to return to the runway after a power loss after takeoff, can lead to an overwhelming emergency at low levels. They need to be able to teach their students how to recognize these situations. They need to be able to teach their students how to recover from these stalls as soon as the wing drops and before autorotation develops.

Removing the spin from private pilot training is not the solution that Canada should be embracing, but a move toward the stall/spin awareness emphasis seen elsewhere is recommended provided that the following steps are taken:

1. Replace the spin on the private pilot flight test with a second stall, an advanced stall.
2. Place more emphasis on the proficiency of private pilot students in recognizing and recovering from advanced stalls.
3. Give examiners better guidance on how to test the advanced stall.
4. Require that spins and the correct recovery technique continue to be demonstrated during private pilot training.
5. Sample the advanced stall more heavily on instructor rating flight tests.
6. Emphasize the teaching of advanced stalls on instructor refresher courses.
7. Continue to require spin training and testing for commercial pilots but use the development of the integrated commercial program to give more specific recommendations for improvement.
8. Enhance training in the teaching of spins and advanced stalls during instructor rating training.
9. Continue to sample the teaching of spins and advanced stalls on instructor rating flight tests. △

Focus on CRM

For the next few issues, the ASL will feature a series of articles dedicated to crew resource management (CRM) awareness. In response to Transportation Safety Board of Canada (TSB) Recommendation A09-02, Transport Canada (TC) agreed to require commercial air operators regulated under subparts 703 and 704 of the Canadian Aviation Regulations *(CARs) to provide contemporary CRM training to their pilots. It was decided that in consultation with industry stakeholders, TC will develop an updated CRM training requirement for 703 and 704 operators, which will also apply to single-pilot operations. Since CRM is not a static concept, but rather an evolving science, TC will also enhance or replace the current CRM training requirement for 705 operators, and consider harmonization with the recently released final* FAA rule Amendment No. 135-122, *Crew Resource Management Training for Crewmembers in Part 135 Operations. A focus group will tackle these issues, and progress updates will be published in the ASL. Our first feature article on CRM is entitled "Emotionally Enabled" and was written by Shari Frisinger. It was previously published by the Flight Safety Foundation.*

Emotionally Enabled

by Shari Frisinger. This article was originally published in the August 2010 Issue of Aero Safety World, *and is reprinted with permission of the Flight Safety Foundation.*

We watched in astonishment when Chesley Sullenberger in early 2009 skillfully piloted US Airways Flight 1549 to a safe landing in the Hudson River, and listened in horror a month later when we heard of Colgan Air Flight 3407 crashing into a Buffalo, New York, U.S., suburb.

Among the factors that caused one perfectly good aircraft to fall out of the sky, killing 50 people, while another very crippled aircraft made a safe water landing that resulted in only a few minor injuries, technical flying skills obviously play a major role. However, success or failure to a large degree can be linked to the captain's ability to control his own emotions in order to think clearly, while being aware of the crew's emotional and mental states.

When the role pilots play in aircraft incidents and accidents is considered, the initial focus of the U.S. National Transportation Safety Board (NTSB) and many analysts is on the technical abilities of the pilots: When was their last recurrent training? How many flight hours did they have in the aircraft type? How many total hours of flight experience?[1]

But some time ago it was realized that technical skills are not the only desirable traits a captain should have. Many years ago, airlines implemented cockpit resource management (CRM) techniques to enhance crew coordination. This new concept was partially based on a U.S. National Aeronautics and Space Administration investigation that discovered a common theme in many accidents—*failure of leadership and ineffective crew interaction.*

CRM focused on how the crew interacted in the cockpit, not necessarily on acceptable or appropriate cockpit behaviors. During the first decade of CRM use, it morphed into crew resource management, to include helping all crewmembers work more effectively as a team, improving situational awareness and providing techniques to break the error chain.

CRM has become a training mainstay. To date, CRM has included only the technical skills and thinking abilities—analytical, conceptual and problem solving. However, research beginning in the 1980s demonstrated that emotions greatly influence a person's cognitive abilities.

To be effective, the next level of CRM needs to include more of the "people" side—self-confidence, teamwork, cooperation, empathy and flexibility in thoughts and actions. A major factor in maintaining the safety of the crew and passengers is the combination of the leader's objective thought process and his or her emotional awareness.

The word "emotion" may conjure up negative elements that tend to degrade safety: anger, fear, crying, shouting and other unhelpful behaviors, but everyone every day experiences more subtle varieties of emotion.[2] In the cockpit this might include satisfaction for having achieved a smooth landing, pride in maneuvering around turbulence, excitement in getting desirable days off, irritation when plans don't work out, and sometimes annoyance with others.

Regardless of the situation, there always exists some degree of emotional response, and emotions are simply another

1 Helmreich, R.L.; Merritt, A.C.; Wilhelm, J.A. "The Evolution of Crew Resource Management Training in Commercial Aviation." *The International Journal of Aviation Psychology.* Jan. 1, 1999.

2 Goleman, D. "What Makes a Leader?" *Harvard Business Review.* Jan. 1, 2005.

type of information that must be considered in making effective decisions, especially in a team environment.

A high degree of situational awareness relies on a person being attentive to the environment. Internal situational awareness consists of understanding one's own emotions and emotional triggers. External situational awareness involves insights into team members' moods and unspoken communication, and appropriately addressing them.

The cornerstones of emotional intelligence (EI) are consciousness of one's thoughts and moods, of how the behaviors resulting from those impact and influence others, and of the moods and behaviors of others.[3] People with a high level of EI recognize and control their own emotional outbursts, step back from the heat of any situation, analyze it objectively and take the appropriate action that produces the most desirable results.

A person's perception of reality shapes emotions and feelings, and these drive thoughts and behaviors. Status quo is maintained until new strong feelings are experienced. Simply being unhappy in a job is usually not enough to warrant a change. Getting passed over for a promotion, accompanied by the belief that the decision was wrong, usually sparks anger and an active job pursuit.

"Emotional Intelligence" means being aware of an entire crew's mental state, not just your own.

The amygdala is the part of the brain that controls a person's level of emotional reactivity. It never matures, and, if left unchecked, it can bring chaos to a life. To compound the problem, the human brain instinctively cannot distinguish between a real threat and an imagined one.

Sitting in a theater, watching a panoramic or 3-D movie, the sudden loud sound of an airplane approaching will make most people reflexively duck. Intellectually, they know the airplane is not real, but the emotional brain hears the loud sound and tells the body it needs to avoid getting hit. When a situation changes, the emotional brain determines if the stimulus causing the change is a threat. If a threat is sensed, awareness becomes heightened and physiological changes take place to cope with this new danger. Adrenaline is released to pump the heart faster and prime the muscles for action. If the situation is later deemed to not be a threat, logic and objectivity take over again, but it takes four hours for the adrenaline to dissipate from the body.

Today's fears, threats and dangers are not unlike those of prehistoric man. A flight department manager who needs to justify the expenses of his department can experience the same "fight or flight" reaction that the caveman did when faced with a saber-toothed tiger. A similar reaction occurs when people feel their reputation or credibility is threatened. Fear and stress envelop thinking and people overfocus on a narrow selection of solutions, disregarding alternative approaches.

When people allow their stressed brains to overtake thoughts, the perspective narrows and the main focus becomes escaping from the situation. Unable to think of alternatives, they don't see the "big picture" or question assumptions. At this level of thought, perception of the complexity of the situation becomes paralyzing, and the focus is on current limitations. Remember the last time you became angry during an argument? It probably wasn't until later, after you could see the situation without emotion, that you thought of several obvious points that could have helped your case. These become apparent because your rational mind was back in control. Your primary focus, in the midst of that argument, was to defend yourself. Success is more assured when this emotionally downward-spiraling thinking is halted and the problem is addressed more creatively.

The captain in the Colgan Air 3407 accident chose the "flight" reaction; he chose to avoid a developing situation.[4] When the first officer brought up the icing conditions — "I've never seen icing conditions. I've never deiced. I've never seen any, ... I've never experienced any of that" — the captain's response was, "Yeah, uh, I spent the first three months in, uh, Charleston, West Virginia and, uh, flew but I — first couple of times I saw the amount of ice that that Saab would pick up and keep on truckin' ... I'm a Florida man ... ." Then he added, "There wasn't — we never had to make decisions that I wouldn't have been able to make but ... now I'm more comfortable." The captain was still unaware of what was rapidly developing around him, chatting while the aircraft's airspeed rapidly decayed. His failure to quiet his instinctive emotions narrowed his perception to the point that airspeed, one of the most basic elements of flying an airplane, no longer had his attention.

There were few instances when the captain referred to the first officer's health. He did not ask how she felt about her ability to perform her flight duties, even though she sneezed twice and six minutes later, she mentioned her ears. Basic understanding of CRM and crew performance should have tipped off the captain that the first officer was

3 Mayer, J.D.; Salovey, P.; Caruso, D.R. "Emotional Intelligence: Theory, Findings, and Implications." *Psychological Inquiry*. Jan. 1, 2004.

4 NTSB, Colgan Air 3407 cockpit voice recording. www.ntsb.gov/Dockets/Aviation/DCA09MA027/418693.pdf

not feeling well that day and her performance could be negatively impacted. A person with higher EI could have recognized that, and probably would have been empathic to her condition and her inability to actively participate as a viable crewmember.

The captain told stories for most of the flight. At one point, he rambled for over three minutes while the first officer only said 34 words, most of which were "yeah" and "uh-huh." Research on how the mind processes information has revealed that people can only consciously execute one task at a time, and unconsciously perform one additional task. When driving in heavy traffic or merging onto a freeway, are you able to continue your conversation? Your mind moves from the conversation you were having to looking at traffic, calculating vehicle speeds and analyzing the best opportunity to speed up and merge. Your automatic mind does not have the ability to safely handle non-routine driving tasks.

A classic example is United Airlines Flight 173, a McDonnell Douglas DC-8, which in 1978 was destroyed when it crashed during an approach to Portland (Oregon, U.S.) International Airport.[5] The captain's intense preoccupation with arranging for a safe emergency landing prohibited him from considering other anomalies. His concentration was so focused on the emergency landing checklist that he did not modify his plans when the first officer and flight engineer twice warned him about their airplane's dwindling fuel supply. Ten people were killed when the aircraft crashed into a wooded area due to fuel exhaustion.

The NTSB said, "The probable cause of the accident was the failure of the captain to monitor properly the aircraft's fuel state and to properly respond to the low fuel state and the crewmembers' advisories regarding fuel state. ... His inattention resulted from preoccupation with a landing gear malfunction and preparations for a possible landing emergency."

This accident was one of the key events driving the adoption of CRM in airline training.

Contrast the reactions and situational awareness of the Colgan and United crews to those of the captain of the US Airways A320 that landed in the Hudson River. Sullenberger kept his emotions under control and remained focused on doing his job—to safely land the plane.

The captain's words "my airplane" when he took over the controls after the bird strike could have been trigger words, words to focus on, snapping his rational brain into action and putting him into a safety frame of mind. He repeated the commands from the first officer, indicating that during those critical seconds there was no room for any misunderstanding. This flight crew's emotional intelligence was as good as it gets, which enabled their processing information quickly and using every resource available to them at the time.

The captain of United Airlines Flight 232, a McDonnell Douglas DC-10 that in 1989 attempted to land in Sioux City, Iowa, U.S., with catastrophic hydraulic and flight control systems failures, could have reacted to his challenges by becoming indecisive, shutting out the crew or dictating orders to them.[6] If he had responded in any of these ways, the captain would have reflected the emotional pressures he was experiencing, and, as a result, his crew would have had his pressures added to their own. Instead, he worked as part of the crew, alternating between giving direction and explaining his actions and taking input from anyone in the cockpit, including a training pilot. Emotions are contagious, and the strongest expressed emotion will be felt unconsciously by others and mimicked. In this case, the captain's calm demeanor was mirrored by the crew and they were able to contain their emotional reactivity.

Aviation history is overflowing with accidents due to pilot error. Many of them could have been avoided if the crews were more aware of their own emotional reactivity and those of the others. Captains infected with "captainitis" are so absorbed in their own world that they lose their situational awareness. The captain in Colgan Air 3407 was self-absorbed, talking about himself for nearly 20 minutes of the last 40 minutes of the flight, missing a number of clues that eventually led to the crash; on the other hand, the captain of US Airways 1549 maintained his composure throughout his short flight and focused on every element of the emergency.

Why is EI relevant? The Center for Creative Leadership found that the leading causes of failure among business executives are inadequate abilities to work well with others, either in their direct reports or in a team environment. Another study of several hundred executives revealed a direct correlation between superior performance and executives' ability to accurately assess themselves.

What actions demonstrate an increased level of EI?

- When crewmembers voice their concerns in a calm, firm manner, giving evidence to back up those concerns;

5 Aviation Safety Network. www.aviation-safety.net/database/record.php?id=19781228-1

6 Aviation Safety Network. www.aviation-safety.net/investigation/cvr/transcripts/cvr_ua232.pdf

- When leaders acknowledge the atmosphere and question crewmembers in a non-defensive manner to determine the causes of the uneasiness; and,
- In a crisis or stress situation, when leaders maintain their composure and communicate more frequently and more calmly with the crew.

There are several techniques that can raise your level of EI:

- Be aware of the thoughts going through your mind. Are they stuck in the past and wallowing in problems, or are they focused on the future and actively looking for solutions? Once we choose negative thoughts, they can very easily spiral downward, the cycle descending into hopelessness.
- Acknowledge your emotions. Remember they are neither good nor bad, they are what they are. Next, identify these emotions: Angry? Irritated? Defensive? Disappointed? Guilty? Frantic? Miserable? Naming your emotions makes them less abstract and helps release their influence on you. It becomes easier to detach yourself and think objectively.
- Look back over your previous reactions. How could you have made a better choice? What information and alternatives are clear now that weren't at that time? As we frantically search for quick solutions to rectify the situation, we automatically use the techniques that we have used before, whether they are the best choice or not. Our mind is not free to explore new alternatives.
- Put yourself in the other person's position. How would you react if you were on the receiving end of your emotions? The other person's brain will send him through the same fight/flight/freeze reaction that yours is experiencing. Imagine both people fighting for their pride or their reputation—chances are slim that the discussion will end well.

Leaders need a considerable amount of cognition.[7] The ability of the leader to broaden his or her focus from technical and task-related activities to include an awareness of the moods of the crew is critical to success. It would benefit all parties to know which skills in specific circumstances are most appropriate. A leader's behaviors directly affect the team's disposition, and the team's disposition drives performance. When the leader can analyze and manage his or her own emotional reactivity, the team members can more easily manage their own emotions. How well the leader performs this can have a direct effect on the safety and morale of the crew.

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7 Helmreich et al.

ANNOUNCEMENT

New Application Forms for all Flight Crew Permits and Licences

Transport Canada (TC) has replaced the current *Application for Flight Crew Permits* form (TP 26-0194) with 12 individual application forms specific to the individual permit or licence. TC regional licensing offices will still accept the use of the old application form until further notice.

NEW application forms have the following features:
- available on the TC Flight Crew Licensing Web site and in the TC Forms Catalogue;
- available in English and French;
- detailed application guidelines provided;
- available in PDF format;
- completed online or manually;
- electronically saveable; and
- letter size for printing on a home printer.

Emphasis has been placed on applicants to ensure that they have met all the *Canadian Aviation Regulations* (CARs) licensing requirements prior to submitting the application to TC.

For additional information, please see Advisory Circular 401-002: *Application Form Guidelines for Permits and Licences* www.tc.gc.ca/eng/civilaviation/opssvs/managementservices-referencecentre-acs-400-menu-479.htm.

TC Forms Catalogue: wwwapps.tc.gc.ca/Corp-Serv-Gen/5/Forms-Formulaires/search.aspx.

For further clarification, please contact a TC regional licensing office.

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Air Intake Filters: Technologies Used to Keep Contaminants Out

by Ronald Donner, Editor, Aircraft Maintenance Technology *(AMT) on-line magazine (www.amtonline.com). This article originally appeared in the May 2010 issue of AMT magazine and is reprinted with permission.*

Keeping dust from reaching the internal workings of any reciprocating engine is critical. According to publications from both Lycoming and Continental unfiltered air contains contaminates which are very abrasive to engines, especially reciprocating engine cylinder walls and piston ring faces. If a worn, poorly fit, or poorly functioning inlet air filter allows as much as a tablespoon of abrasive dirt in the cylinders, it will cause wear to the extent that wear to internal parts of the engine will prematurely occur and an overhaul will be prematurely required.

For most general aviation (GA) aircraft powered by reciprocating engines there are four different technologies currently in use to protect today's reciprocating engines. These four technologies can be further broken down into two different categories: "dry media" and "wet media." Let's take a closer look at these two basic types of inlet air filters.

We'll begin with the dry media filter. As its name implies "dry media" filters feature a filtering medium that—well, is dry. A dry media filter does not require the use of oil as part of the filtering process. Historically, the filtering media has been made using cellulose or paper fibers. Today a large portion of these filters have a man-made synthetic fiber, or fiberglass as the filtering media. This media, regardless of the material type, is then pleated into the "accordion" shape to make the filter. The filter media is then encased in a frame designed to fit the specific engine and aircraft application. This style of filter is currently found on multiple GA reciprocating engine aircraft applications.

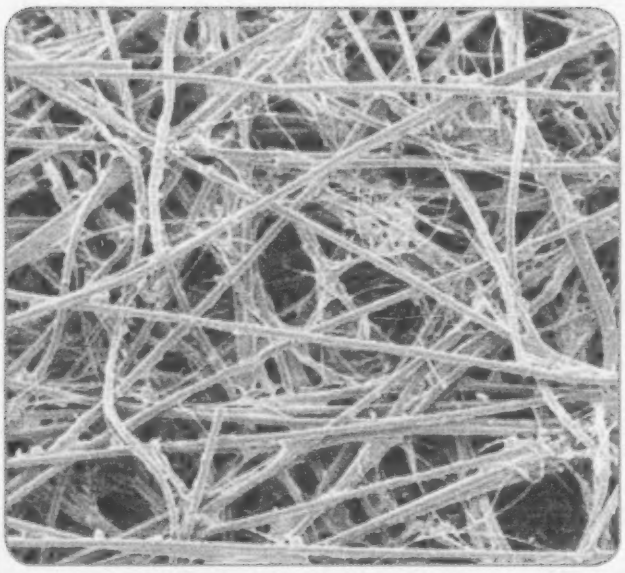
Next is the wet media filter, which is the other popular filter technology which is found in use on GA aircraft today. Wet, as its name implies, is a type of media that requires a tacky oil to be applied to a substrate to act as the dust trapping agents. The substrate is most commonly either a foam pad or pleated cotton gauze. Typically this filter substrate alone offers only a limited portion of filtration protection. However, once tacky oil is applied to the substrate the effectiveness increases dramatically. Wet media filters require that oil is always present on the substrate in order to ensure the best filtering action. Consequently as the filter media dries out, the efficiency of these filters becomes modified. In some cases wet media filters will require that oil is re-applied as part of the normal servicing for the aircraft. Additionally, care must be taken to not wash away the oil from the foam pads.

The following is a general description and guidelines to follow when inspecting and servicing induction air filters:

Dry media filters

Dry media filters can be either a cellulose or synthetic media. The tight weave of the media traps particles by sieving the dust contaminates. The pleated style of the media maximizes the surface area of the filter providing the engine maximum area to breathe. Most GA original equipment manufacturers (OEM) use a dry media pleated filter on their equipment. The dry media pleated filters are designed to offer long life, approximately 500 flight hours or three years of service, and they can be cleaned up to five times before replacing them. Cleaning can be initially performed by using compressed air to expel any dust and particulate that has been trapped in the filter pleats. Once all of the dust and particulate has been blown away, you should hold the filter up to a light source and inspect the condition of the media for deterioration. If the media is in satisfactory condition, further cleaning can be accomplished by washing the filter in a solution of water and general purpose low-suds detergent. After washing, the filter should be dried and once again inspected for contamination and general condition. The following steps can be used as a guide when servicing the dry media filter:

1. Remove the filter and inspect for damage or deterioration.
2. Pre-clean using compressed air to blow off the dust and particulate.
3. Wash and soak with water and detergent.
4. Rinse the filter.
5. Dry the filter.
6. Re-inspect and re-install.



The tight weave of the dry media traps particles by sieving the dust contaminates.

Photo: Donaldson Aerospace and Defense Group

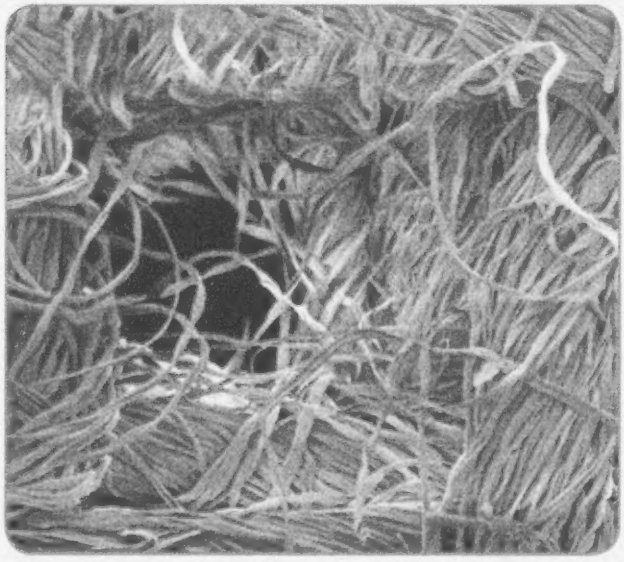
Wet media filters

Wet media filters generally fall into two different classifications: oiled foam and oiled cotton gauze. The oiled foam style filters contain a low-cost replaceable pad, which is saturated with tacky oil that provides its filtration efficiency. The foam pads are contained inside of a filter frame for easy removal and replacement. These foam pad wet media filters have been primarily an aftermarket part, approved for installation by way of a supplemental type certificate (STC). The foam pads are required to be replaced on a regular basis, typically every 100 flight hr or when 50 percent of the surface is covered with contaminants or debris. The cost of the replacement foam filter pads are low and this type of air intake filter is popular on many GA aircraft models. There really is no maintenance servicing for this style of wet media foam pad filter—only remove and replace.

The other wet media technology is the gauze-pleated filter. This media consists of layers of surgical cotton gauze that is pleated between wire screens and then coated with oil. This technology has migrated into the GA aircraft industry from the automotive industry. The highly permeable cotton gauze is used to support tacky oil to provide its filtration efficiency. The gauze-pleated wet media filters have also been an aftermarket part, approved for installation by way of an STC. The following steps can be used as a guide when servicing the wet gauze-pleated filter:

1. Remove the filter and inspect it for damage or deterioration.
2. Gently tap filter on a hard surface to remove loose dust that will easily fall off the filter.
3. Apply the cleaner to clean side of filter.
4. Apply the cleaner to dirty side of filter.
5. Let the cleaner soak for 10 min.
6. Rinse with water.
7. Dry the filter without accelerated drying methods.
8. Re-oil the filter substrate.
9. Let sit for approximately 20 min and check for oil coverage.
10. Re-oil any areas of the filter that were initially missed.
11. Continue steps 5 through 7 until a uniform colour covers the entire filter media.

The cleaning procedures for this type of filter are recommended every calendar year or every 100 flight hr, and can be cleaned up to 25 times or a maximum of 2 500 flight hr.



Wet media, as its name implies, is a type of media that requires a tacky oil to be applied to a substrate to act as the dust trapping agents.

Photo: Donaldson Aerospace and Defense Group

No matter which type of air intake filter is used, when operating a reciprocating engine-powered aircraft in sandy or dusty conditions, it may be necessary to service the air intake filter(s) much more frequently—even daily. Use only the cleaning procedures, cleaning fluid, and the correct type of re-oiling fluid that are recommended by the filter manufacturer or aircraft maintenance manual. Failure to follow the required cleaning instructions on any type of air intake filter can lead to poor filtering efficiency which can eventually lead to premature wear and damage of internal engine parts.

When choosing an air intake filter system for your customer's aircraft, consider all of the options. Calculate the initial costs, the cost of ongoing filter servicing tasks, and the cost of ongoing element replacement. Some air intake filter systems have service bulletins and airworthiness directives requiring certain maintenance actions.

More information regarding care and servicing of air intake filters can be found by contacting the manufacturer of the aircraft and engine.

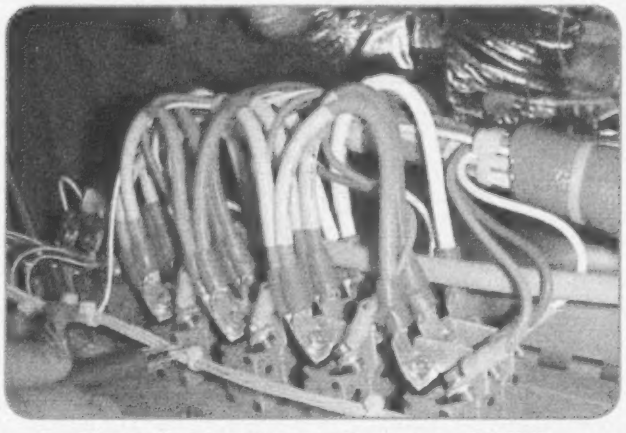
Information for this article was provided by Scott Petersen, Account Manager for the Donaldson Company's Aerospace and Defense Group. △

Fuel Tank Safety and Electrical Wiring Interconnection Systems—Considerations for Transport Airplane Modification and Repair Designs

by Blake Cheney, Manager, Domestic Regulations, Aircraft Certification Standards, Civil Aviation, Transport Canada

The business of modifying and repairing transport category airplanes can be complex. A spectrum of engineering design challenges related to any specific modification or repair necessarily compete with the business realities of financial and time constraints. As always, it is necessary to be wary of aircraft level risks that may be inadvertently introduced with the installation and integration of new design changes to any aircraft.

Accident examples have raised awareness regarding the need for new best practices to protect against aircraft level safety risks associated with modification (and repair) of fuel tank systems, including adjacent areas, and the installation and maintenance of electrical wiring interconnection systems (EWIS). EWIS is defined in *Airworthiness Manual* (AWM) 525.1701 as "any wire, wiring device, or combination of these, including termination devices, installed in any area of the airplane for the purpose of transmitting electrical energy between two or more intended termination points." EWIS does not include electrical equipment or avionics qualified to acceptable environmental conditions and testing procedures, portable electrical devices that are not part of the airplane's type design, or fibre optics.



Electrical wiring interconnection systems (EWIS)

In the United States, the Federal Aviation Administration (FAA) has codified these best practices under *Special Federal Aviation Regulation* (SFAR) No.88 and 14 CFR 26.11 *Enhanced Airworthiness Program for Airplane Systems* (EAPAS). In particular, these requirements apply to transport category, turbine-powered airplanes with a type certificate issued after January 1, 1958, that, as a result of the original certification or a later increase in capacity, have:

(1) a maximum type-certificated passenger capacity of 30 or more; or

(2) a maximum payload capacity of 7 500 lbs or more.

In the case of fuel tank systems, a worldwide effort by transport airplane design approval holders (DAHs) to re-evaluate their designs has resulted in the development and promulgation of numerous design changes and Instructions for Continued Airworthiness (ICA) (including Limitations), most importantly by airworthiness directives (AD). Much knowledge of the specific vulnerabilities of fuel tank system designs with respect to the development of ignition sources was gained through this safety exercise. New best practices are now recognized as necessary to minimize the development of fuel tank system ignition sources stemming from possible heat sources, electrical arcing (including lightning-induced arcing), or mechanical sparking (each arising from normal operation, single failures or combinations of failures that are not extremely remote).

In the case of EWIS, DAHs had to make a similar large-scale effort to evaluate the need for, prepare, and make available any additional maintenance and inspection tasks, developed using the Enhanced Zonal Analysis Procedure (EZAP) methodology, that may be required for the EWIS.

The EZAP is an analytical procedure that identifies the physical and environmental conditions in each zone of an airplane, analyzes the effects of these conditions on EWIS, and assesses the possibilities for smoke and fire. From EZAP analysis, maintenance tasks can be developed to detect EWIS degradation issues, prevent ignition sources and minimize possibilities for combustion by minimizing accumulation of combustible materials. The resulting EWIS EZAP ICAs are to be presented in

the form of an appropriate informational document and will be easily recognizable as EWIS ICA. The goal of the resultant enhanced cleaning and inspection tasks is to have fewer EWIS failures, which leads to safer operation.

During the zonal inspections, EWIS would be checked for unacceptable conditions, including:

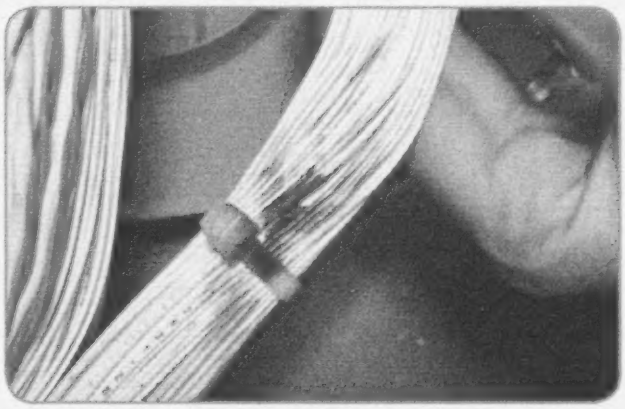
- wire bundle chafing, sagging or improper attachment and securing;
- wire damage (obvious damage due to mechanical impact, overheat, localized chafing, etc.);
- wiring protection sheath/conduit deformity or incorrect installation;
- contamination, such as dust and lint accumulation, surface contamination by metal shavings/swarf, and liquids;
- deterioration of splices, whether from production or previous repair;
- inappropriate repairs (e.g. incorrect splice);
- grommets missing or damaged;
- lacing tape and/or ties missing/incorrectly installed; and
- wires riding on, or inadequate separation from, fluid lines.

Most manufacturers will conduct the EZAP through the Maintenance Review Board (MRB) process (using MSG-3 v2005.1 or a later version). However, Supplemental Type Certificate (STC) applicants will likely conduct the EZAP by other means outside the MRB process, such as via a Maintenance Type Board (see TP 13850). Typically, Transport Canada Civil Aviation (TCCA) aircraft evaluation or regional maintenance inspectors would participate in and/or review the results of the EZAP, with input from headquarters or regional aircraft certification engineers. The EWIS ICA would be included in an approved section of the ICA document(s) pertinent to each design approval.

Once generated, these EWIS ICAs are required to be placed in Canadian commercial air operator-approved maintenance schedules, pursuant to CAR 605.86, to meet the requirements of Standard 625, appendices C and D.

These wiring lessons have been learned and documented as recommendations from the Transportation Safety Board of Canada's (TSB) investigation into the Swissair 111 accident. Among other findings, the TSB asserted that wiring discrepancies found on many aircraft reflected a shortfall within the aviation industry in wire installation, maintenance, and inspection procedures. In particular, the TSB identified that:

- current maintenance practices did not adequately address wiring components;
- wiring inspection criteria were too general;
- maintenance instructions did not describe unacceptable conditions in enough detail; and
- airplane wiring needed to be considered as a discrete system and given the same level of scrutiny as other airplane systems.



Wire chaffing issue

To ensure that the achieved safety objectives of the fuel tank system and EAPAS industry-wide safety reviews and retrofits are maintained for the operational life of the reviewed airplane models, we need to ensure that future design changes do not degrade the achieved level of safety in the fleet.

On a go-foward basis, the FAA is applying the fuel tank system and EWIS EZAP ICA requirements to all new design changes to transport category airplanes, pursuant to specific regulations. These requirements may be over and above the requirements of 14 CFR Part 25/AWM 525, or those otherwise established in the airplane's basis of certification. Transport Canada (TC) and the European Aviation Safety Agency (EASA) are also applying these same design requirements for new design approval applications, citing that the design may have (unsafe) features that were not foreseen in the existing certification basis; for that reason, it establishes these new design requirements as applicable standards for a design approval application. Moreover, there are existing requirements that provide that there may not be design features or details that experience has shown to be hazardous or unreliable. Further, in view of the hundreds of ADs issued to correct in-service deficiencies relating to fuel tank safety, failure to follow the revised "best practices" would be considered an unsafe feature or characteristic, and on that basis TCCA or EASA may refuse to issue the design approval.

EASA has further clarified in NPA 2007/01 that it supported the retrospective design reviews and would send letters to request review of ICA to incorporate

results of EZAP by DAH holders. ADs would be issued to non-cooperative DAHs, pursuant to the EASA Implementing Rule (IR) 21A.3B(c)(1). In addition, pending modification of type certificate data sheets, generic special conditions quoting the relevant paragraphs of CS-25 as modified by the EWIS NPA will be systematically issued for approvals of modifications affecting EWIS when application is after the amendment to CS-25 (September 5, 2008). As in Canada, any EWIS ICAs developed under the EZAP must be placed in European operators' maintenance programs, pursuant to IR Part-M.302.

Each new design change that may affect the airplane fuel tank system should not introduce additional fuel tank ignition hazards to those that may already be present in the unmodified design. The design change applicant must demonstrate compliance with the design standards of AWM/FAR/CS 525/25.981(a), (b) and Appendix H525/25.4 (change 525-11, equivalent to FAR Amdt. 25-102).

Similarly, for each aircraft zone containing EWIS that is affected by the design change, especially where the characteristics of the zone (e.g. susceptibility to systemic accumulation of dust and lint, proximity to hydraulic and mechanical flight controls, zone density) may be affected, it must be determined whether any specific EWIS ICA may be required, using the EZAP methodology in accordance with AWM Appendix H525.5*(a)*(1) and *(b)* (change 525-16, equivalent to FAR Amdt. 25-123).

These actions are the cumulative result of past experience and in-depth reviews. They are intended to promote safety of the transport airplane fleet through certification and continued airworthiness processes. △

Floats—a Seasonal Problem

The following article was originally published in Aviation Safety Maintainer *Issue 1/1988, and is republished in this issue for its pertinence to this day.*

Spring is fast approaching and, with the melting of ice on lakes and rivers, aircraft owners and operators scramble to change over from winter ski and wheel kits to floats or amphibious landing gear. A search through some accident files suggests this can spell big trouble for the unwary AME after installation of an unserviceable or incorrect kit.

Accidents caused by faulty float or amphibious gear maintenance include those of an amphibious Cessna 185 that flipped onto its back during a water landing. This accident was due to a hung landing gear wheel that did not retract because of a defective pin in the mechanism. Also, a Cessna 185 Skywagon lost a panel of a float during flight because it was improperly fastened.

Again, a Cessna 185 floatplane veered right and rolled over during takeoff on a test flight because previous float repairs failed.

An amphibious Beaver was being flight tested following maintenance on the landing gear system. A circuit was flown, the gear cycled, and landing on the runway was completed. Following another takeoff, the pilot attempted a water landing; after touchdown, the aircraft cartwheeled and overturned. The investigation revealed that the left rear gear had failed to retract for some undetermined reason. In this case the pilot did not check the position and locking of the gear to determine if it was in the UP position. Inadequate inspection or other maintenance factors cannot be ruled out as contributory factors in the accident.

A review of one aircraft log book in the Western region did not uncover any entries related to float inspection, nor were the inspection items for floats added to the aircraft inspection schedules. Additional inquiries to other operators revealed that many were aware of neither maintenance requirements nor formal inspections on floats.

There seems to be a general lack of seasonal maintenance coupled with poor record keeping on float kits. This leaves floats transferred from one aircraft to another particularly vulnerable, since little service history accompanies the floats when this occurs.

What can the AME do to improve the safety of float installations? The place to start is with a close look at the nameplate on the float and then at the type certificate, to make certain the aircraft/float installation you are certifying is approved. Following this strategy, check that the installation conforms to available manufacturer's information or drawings, and that all the hardware used is new or in good condition. Also include a check for proper installation of any supplementary type approvals (STA) and/or supplementary type certificates (STC) and that all applicable Airworthiness Directives (AD) have been carried out. Next, inspect the floats for evidence of repairs or corrosion, and, if repairs are found, make sure they comply with an approved repair scheme and that any skin replacement conforms to the manufacturer's specifications. If corrosion is found, remove it and repair the floats as necessary. If in doubt, contact the float manufacturer or an approved overhaul facility for advice.

The following lists of items are compiled under the headings: Floats, Amphibious gear and Aircraft. These lists are not intended to be used as a formal checklist, but to serve as a reminder to the AME that considerable study and investigative work is required to install floats correctly and enhance safety.

Floats:

- Check for attachment of the manufacturer's nameplate.
- Check for required spacers, condition of attachment bolts, attachment fittings and associated structure for evidence of corrosion.
- Check springs, cables, rigging and attachment points of water rudders.
- Look for assemblies that have an excess number of washers and corroded bolts or fittings, and reassemble correctly using new parts.
- Assemble all mechanisms using plenty of grease.
- Check convenience items, such as steps or handles for proper approval.
- Check for bogus parts and verify manufacturer's part numbers and parts manufacturer approval (PMA) stamp where bogus parts are suspected. This is very important.
- Watch for parts incorrectly heat treated, particularly important when repairs are being made; major repairs must be certified by an authorized inspector.
- Examine spray rails for condition and evidence of repairs.
- Look for patched or repaired spreader bars; in most cases this type of repair is illegal and susceptible to corrosion.
- Check condition of streamlined brace wires and cables. Remove from service any streamlined brace wire showing evidence of repair by welding.
- Check composite floats for evidence of delamination and loosening of fittings (special expertise is needed when repairing composite floats).

Amphibious gear:

- Check for attachment of the manufacturer's nameplate.
- Check for proper operation and condition of gear and water door mechanisms, particularly for correct gear position and associated cockpit position indications.
- Lubricate and retract mechanism paying particular attention to springs, bolts, pivot arms and worn or corroded detents. Test the hydraulic system for correct operation.
- Check brakes and replace worn or heavily corroded disks or other parts.
- Check microswitches for cleanliness and correct electrical operation, including operation and indication of the gear position indicator.
- Inspect and lubricate all pulleys, slide tubes and cables.
- Check baggage compartments located in floats. These must maintain structural integrity and be approved.

Aircraft:

Don't forget to check for the extra items that must be considered for the aircraft when installing float kits. Again, start with the aircraft approval, supplementary type approvals, and float approval documents or certificates and verify, where applicable, the conformity of items such as:

- vertical fin modification (if required);
- correct propeller installation;
- exhaust extension (if required);
- correct type of springs on water rudders;
- changes to rigging such as flap limits in float configuration;
- whether flight controls need re-rigging;
- instrument markings for float operation—particularly the airspeed indicator;
- any extra bracing—V braces in the cockpit, etc.;
- corrosion proofing (if required);
- float fittings or other attachment parts (look for bogus parts); and
- any items that call for dye penetrant inspection prior to installation.

Finally, after the installation is complete, go back and recheck all the items called for on the inspection sheet and applicable airworthiness directives. Then complete the necessary log entries indicating that a new float or amphibious installation or re-installation is released for flight in a serviceable condition, and that all airworthiness directives have been complied with. △

RECENTLY RELEASED TSB REPORTS

The following summaries are extracted from final reports issued by the Transportation Safety Board of Canada (TSB). They have been de-identified and include the TSB's synopsis and selected findings. Some excerpts from the analysis section may be included, where needed, to better understand the findings. For more information, contact the TSB or visit their Web site at www.tsb.gc.ca. —Ed.

TSB Final Report A07P0357—Loss of Control—Collision with Building

On October 19, 2007, at 16:02 PDT, a Piper PA-34-200 Seneca was cleared for takeoff from Runway 08 Right at the Vancouver International Airport destined for Pitt Meadows Regional Airport. The flight was operating under VFR with only the pilot on board. Shortly after takeoff, communications and radar contact were lost. The aircraft collided with a 15-storey residential building in Richmond, about 1.5 NM east-southeast of the departure end of Runway 08R. The pilot was fatally injured. There was no post-impact fire. The aircraft entered a suite occupied by two people; one received serious non-life-threatening injuries, the other received minor injuries. Structural damage to the building was minimal, but there was extensive water damage from the fire suppression system. As a result, hundreds of people were displaced from their homes for extended periods. There were no other reported injuries.

Aircraft flight path

Analysis

The identification of the factors that contributed to this accident was hampered by significant destruction of the aircraft and minimal recorded information. Three possible accident scenarios were considered: an intentional act, an equipment problem and pilot response, and pilot incapacitation. These scenarios are analyzed below.

First scenario—an intentional act

The first scenario is that the pilot intentionally flew the aircraft into the building. The pilot's demeanour, his making of ongoing plans, his concern about the correct operation of the aircraft systems, and the care taken to prepare the aircraft for this flight are inconsistent with such a scenario. The TSB investigation did not reveal any indication to conclude that an intentional effort was made to place the aircraft, or anyone, in jeopardy.

Second scenario—equipment problem and pilot response

The second scenario involves a problem with the aircraft or its configuration that the pilot was unable to resolve during the short flight. Several aircraft systems with the potential to affect aircraft performance during the flight were examined and all but two potential system problems were eliminated. This left the possibility of an autopilot electrical malfunction or an electric pitch trim malfunction.

Because this was the first flight following maintenance on the pitch command function of the autopilot system, it would be unusual for the autopilot to have been engaged at such a low altitude, especially in view of the nature of the original complaint. Component damage prevented complete testing of these systems after the accident, but to the extent these systems could be examined, no anomalies were identified.

Following the accident, the anti-servo trim tab on the stabilator was found to be in a moderate nose-down position and the rudder trim was at full right deflection (left rudder input). It could not be determined if either trim setting was made before or after takeoff. It is possible that the pilot inadvertently omitted the checklist item to check and set either or both trims prior to takeoff. A nose-down trim would require the pilot to exert more back pressure to rotate the aircraft during the takeoff roll and could account for the much higher than normal speed over the departure end of the runway. It could not be determined if the electric power switch for the pitch trim was ON or OFF. There was no pre-takeoff checklist item reminding the pilot to turn the electric trim ON. If OFF, the pilot would have had to either turn it on to regain electric pitch trim functionality, or use the manual trim wheel to adjust the pitch trim. If an electric pitch trim runaway occurred during flight, it could be expected that it would have travelled to its limit (full nose-down position) unless pilot intervention limited the travel.

The pilot's experience and skill level should have been sufficient to overcome such events and he had previously demonstrated his proficiency at altitude

to deal with a faulty pitch command function of the autopilot during recurrent training. It was considered a possibility that degraded cognitive performance may have affected the pilot's ability to identify, diagnose, and correct an unexpected pitch or rudder trim anomaly while controlling the aircraft's attitude in the brief time after takeoff and before the collision with the building. However, no evidence of symptoms of reduced cognitive functioning was identified during the investigation.

Therefore, the investigation concluded that it is unlikely there was any system malfunction that could not have been readily overcome by the pilot.

Third scenario—pilot incapacitation

The third accident scenario involves the possibility of an acute medical event resulting in pilot incapacitation. The pilot was diagnosed with several cardiovascular risk factors, making an acute cardiovascular decompensation a possibility. An equally plausible possibility is an acute neurological event (such as a seizure or stroke). The routine medical examination did not detect impairment of cognitive processes or other neurological functions; therefore, further testing was not conducted.

The normal and loud engine operating sounds provided an indication of normal engine and propeller operation, which was confirmed by post-accident examination. High-engine power available from both engines would have contributed to reducing the angle of descent. A conscious pilot would have likely made some effort to correct the descent, to manoeuvre away from the building, or to communicate with air traffic services.

Demonstration showed that it is extremely unlikely for an unconscious pilot to have collapsed onto the control wheel and to have caused the loss of control resulting in the unchecked descent. Therefore, the change from a climb to a descent due to unconsciousness could be the result of two possibilities: the pilot being unable to maintain overriding control input in response to an anomalous pitch trim condition, or a less likely scenario of the pilot making an autonomic electric pitch trim command during the transition toward unconsciousness. In either case, it follows that the aircraft was accelerating in a descent because it had not achieved the airspeed corresponding to the pitch trim position. The erroneous pitch trim setting was not successfully addressed, and before the aircraft could achieve the corresponding speed and level off or resume a climb, it descended below the height of the building and collided with it.

The pilot had pre-existing health risk factors, making it possible that he suffered an acute medical event resulting in incapacitation and a loss of control of the aircraft. The investigation concluded that this is the most plausible scenario.

Impact damage

Findings as to causes and contributing factors

1. The pilot had pre-existing health risk factors, making it possible that he suffered an acute medical event resulting in incapacitation and a loss of control of the aircraft.
2. With the pitch trim at an inappropriate setting, the aircraft accelerated in a descent below the height of the building and collided with it.

Findings as to risk

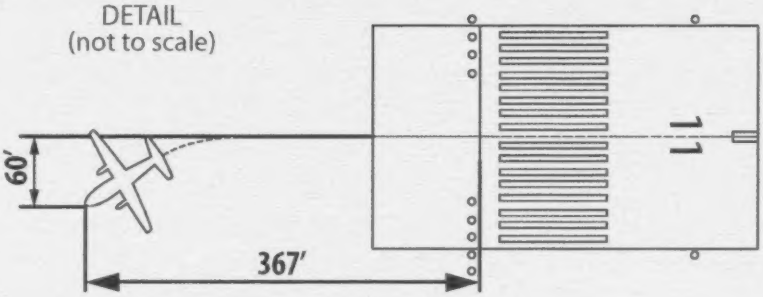
1. Non-disclosure of medical symptoms or chronic conditions to civil aviation medical examiners (CAME) bypasses some of the safety benefit of examinations and may pose a risk of incapacitation while flying and, as such, a risk to public safety.
2. TP 13312 does not address the complete range of conditions that may be affected by age, does not include significant advances since 2001, and does not cover the age range above 74. The guidelines, therefore, are of limited value in assisting CAMEs to detect all pilots with age-related medical risk factors.

Other findings

1. There is no evidence to suggest that the pilot intentionally flew the aircraft into the building.
2. The manufacturers and designers of equipment containing memory devices may not consider their potential use for accident investigation purposes.

TSB Final Report A08W0001—Runway Overrun

On January 4, 2008, a Jetstream 3212 was landing at Fort Smith (CYSM), N.W.T., following an IFR flight from Edmonton, Alta. While landing on Runway 29, at 15:02 MST, the aircraft rolled off the end of the runway and stopped 367 ft from the threshold and 60 ft to the left of the runway centreline. There was about 18 in. of snow in the overrun area. Damage was limited to the number two propeller. There were no injuries to the 2 pilots and 16 passengers.



Aircraft final position 60' from centreline and 367' past runway threshold

Analysis

When the visual approach slope indicator system (VASIS) became visible, the aircraft was above the optimum glide path for a touchdown in the first 1 000 ft of the runway. In the attempt to regain the glide path, the pilot allowed the airspeed to increase to at least 20 kt above landing reference speed (Vref). By the time the aircraft decelerated to a speed allowing a firm touchdown, a considerable portion of the runway was overflown. The remaining 3 400 ft would have been sufficient for the aircraft to stop on a bare, dry runway after a touchdown at, or near, Vref; however, at a higher touchdown speed on a runway with a Canadian Runway Friction Index (CRFI) of 0.18 or 0.34, stopping in this distance could not be assured. Conservative CRFI charted landing distances are designed to cue flight crews to consider aircraft performance options for landing. Reference to CRFI charts prior to the approach would likely have prompted the crew to consider rejecting the landing when the airspeed and height profile exceeded normal parameters.

Findings as to causes and contributing factors

1. The descent profile on final approach was above the optimal approach path for a landing in the runway touchdown zone. The aircraft landed about 3 400 ft from the end of the runway, which afforded insufficient distance to stop on the slippery runway surface.
2. The airspeed during the approach and touchdown was significantly higher than that recommended. This higher speed and the tailwind contributed to the aircraft landing at a point on the runway which afforded insufficient distance to stop.
3. The application of reverse thrust and maximum wheel braking was delayed until aerodynamic drag slowed the aircraft from the touchdown airspeed of 120 kt to 90 kt. The ground roll during that time consumed runway surface available for active braking.
4. Reference to CFRI charts prior to the approach would likely have prompted the crew to consider rejecting the landing when the airspeed and height profile exceeded normal parameters.
5. Prior to the landing, runway maintenance removed a light layer of snow and the previously-applied sand. This resulted in a very low coefficient of friction on the runway that was not measured or reported to the flight crew.

Safety action taken

The company instituted an enhanced pilot training program emphasizing crew resource management, conducting stabilized approaches, decision making regarding go-arounds, and airspeed control on approaches. In addition, quick reference charts featuring required landing distance were placed in company Jetstream cockpits, and required landing distance was to be included in pre-landing briefings.

TSB Final Report A08W0173—Aerodynamic Stall—Impact with Terrain

On August 17, 2008, a Cessna 337 was conducting an aerial fire patrol and wildlife survey with the pilot and a biologist on board, approximately 15 NM west of Beaverlodge, Alta. At 14:37 MDT, the pilot lost control of the aircraft during a low-level turn. The aircraft descended steeply through trees, skidded, and came to rest at the edge of a beaver pond. The aircraft was substantially damaged and the pilot was fatally injured. The biologist, who was seated in the front right seat, sustained serious injuries. The emergency locator transmitter (ELT) did not activate; however, locating the aircraft and survivor was facilitated by the global positioning system tracking equipment installed in the aircraft and the monitoring software used by the client's flight-following personnel.

Other factual information

The primary mission was to conduct a fire patrol. In addition, a Trumpeter Swan cygnet survey was to take place in certain areas, with a wildlife biologist assigned to the flight. Because the cygnets hide in the vegetation, biologists need to get quite close in order to make an accurate count. Wildlife surveys of this nature require the aircraft to be operated at lower altitudes and slower speeds than fire patrols, and it is not unusual for the aircraft to be at tree top height. Speeds and altitudes were always at the pilot's discretion, and it was not unusual for the stall warning horn to sound during these operations. The company operations manual (COM) did not specify training or standard operating procedures for low-altitude wildlife surveys. The only reference to low-altitude flying was contained in the safety training practices section of the COM, which stated that any training shall not be conducted below 500 ft AGL or in the vicinity of wildlife.

Companies contracted for this survey work had to meet the following aircraft specifications and air crew qualifications: for twin-engine aircraft, the pilot shall have 1 200 hr total flying time with 100 hr multi-engine, 200 hr pilot-in-command (PIC), and at least six months operational experience. While the occurrence pilot met the multi-engine and PIC experience requirements, he did not possess 1 200 hr total flying time, nor did he have six months of operational experience.

The COM requires that all flights or series of flights must be authorized, before departure, by the operations manager or the chief pilot, as applicable. Operational control of a flight was delegated to the PIC by the operations manager, who retained responsibility for the day-to-day conduct of flight operations. In the event that a new requirement for a flight develops when operating away from base, the PIC has the authority to release the aircraft. The pilot did not communicate to the chief pilot that the occurrence flight would involve a low-level wildlife survey.

The wreckage trail indicated the aircraft had struck the trees in an approximately 40° left-wing-low attitude, about 40 ft AGL. The trees were estimated to be 35 to 50 ft tall and up to 12 in. thick. The tree swath indicated the descending flight path angle was approximately 45°. The aircraft had skidded and tumbled approximately 80 ft across the shoreline after initial impact with the ground. It came to rest on a small peninsula of land that jutted into the pond. The total length of the wreckage trail, from first tree impact to where the aircraft came to rest, was approximately 136 ft. Aircraft damage indicates that the majority of the impact forces were to the left side of the aircraft.

Analysis

The steep descent through the trees, short wreckage trail, low groundspeed, and steep angle of bank point to a loss of control at low altitude due to aerodynamic stall.

Due to the low altitude, the pilot would have been unable to recover in time to avoid impact with the trees. The biologist in the right seat survived due in part to the aircraft striking a fairly soft terrain feature (marshy swamp) after decelerating through several trees and impacting primarily on the left side of the aircraft. Survivability for the pilot could have been enhanced had he been wearing head protection in the form of a helmet.

Search-and-rescue efforts were delayed because the ELT, though fully functioning, was not able to transmit because the antenna leads were severed during the impact sequence. The GPS tracking system yielded a position that was instrumental in finding the aircraft and surviving biologist before dark.

The operator's COM and standard operating procedures did not address the risks associated with low-level flight. Additionally, the company allowed a pilot to command who did not meet the client's requirements. Operational control was insufficient to mitigate the risks associated with low-level flight, and as a result, the pilot entered into an operational situation that exceeded his abilities.

Findings as to causes and contributing factors

1. The pilot had not been provided with sufficient guidance and training pertaining to low-level aerial surveys; consequently, the pilot's handling of the aircraft was not consistent with safe operations in the low-level environment.

2. The pilot flew the aircraft at low air speed, an angle of bank in excess of 50°, and a high-density altitude; this resulted in an aerodynamic stall.

3. The low altitude of the aircraft prevented recovery from the stall prior to striking the trees.

Finding as to risk

1. Having pilots operate aircraft at low altitudes without specific guidance and training increases operational flight risk.

TSB Final Report A09Q0003—Controlled Flight into Trees

On January 6, 2009, at 04:46 EST, a Piper Cherokee PA-28-140 took off from the Québec/Jean Lesage International Airport, Que., on a night VFR flight to the Saint John Airport, N.B., with the pilot and 3 passengers on board. Approximately 20 min later and about 38 NM east of Québec, the pilot informed the Québec terminal control unit that the flight was encountering a snow shower. Thirty-six sec later, the Québec terminal controller lost radio contact with the aircraft. About 3 min later, the aircraft disappeared from the radar screen. Shortly after, the aircraft struck the southwest slope of the Massif du Sud Mountain, Que. The emergency locator transmitter (ELT) activated on impact. The aircraft was located at 09:06 EST. The aircraft was destroyed, but there was no post-impact fire. The pilot and front seat passenger were fatally injured. The two rear seat passengers sustained serious injuries.

Findings as to causes and contributing factors

1. The pilot undertook a night VFR flight while there was a risk of encountering instrument meteorological conditions (IMC).

2. During the night flight, the pilot inadvertently entered snow showers and lost visual reference with the ground before crashing in controlled flight.

3. The accident occurred at night, when it is harder to avoid bad weather and to see unmarked obstacles.

4. It is likely that the pilot did not use the VFR navigation chart to navigate and, as a result, did not know the exact position of the aircraft or the elevation of the terrain in the area.

5. The aircraft altitude was not corrected to compensate for the low outside temperature. As a result, the true altitude of the aircraft was approximately 500 ft lower than the indicated altitude, thus reducing the safety margin needed to avoid obstacles and the terrain.

6. Although the effects of cocaine on performance in aviation have not been studied, its known effects

indicate that the pilot's use may have contributed to this accident.

Findings as to risk

1. The pilot undertook an extended night flight at the end of the day, with a planned return flight the same day. As a result, the pilot ran the risk of fatigue that may have led to degradation of performance.

2. The time of arrival at the Saint John Airport, N.B., did not allow for spare time. Consequently, the pilot likely felt pressured to complete the flight in a timely manner.

3. The pilot undertook a flight with a gyroscopic heading indicator that was in all likelihood defective, rendering navigation at night over a dark landscape difficult.

4. The aircraft was not carrying adequate survival equipment. As a result, the survivors were exposed to the risk that their physical condition would deteriorate further before rescue personnel arrived.

Other findings

1. The aircraft was overloaded, and the use of the two rear seats was not in compliance with the aircraft certification and flight manual. As a result, the aircraft performance was reduced.

2. The time that passes between the collection and the analysis of blood and urine samples and the method of storage during the interval can have an impact on the effectiveness of an investigation.

TSB Final Report A09C0087—In-Flight Fire

On June 15, 2009, a Bell 204B helicopter, with two crewmembers onboard, was being used to bucket water in support of firefighting operations at Easterville, Man. During a water pickup, there was an electrical burning odour followed by the illumination of a fuel boost pump caution light. The crew aborted the water pickup and transitioned back to the ground staging area approximately

100 m away. The pilot landed the helicopter, shut off the engine, fuel, and electrics, and the crew quickly exited. Flames emanated from the right side of the engine cowling area, the fire spread quickly, and within minutes the helicopter was completely engulfed. The community fire truck was called and arrived within five minutes of the occurrence. The crewmembers were not injured, but the helicopter was completely destroyed. The accident occurred during daylight hours at 17:27 CDT.

Helicopter showing fire emanating from the engine area

Findings as to causes and contributing factors

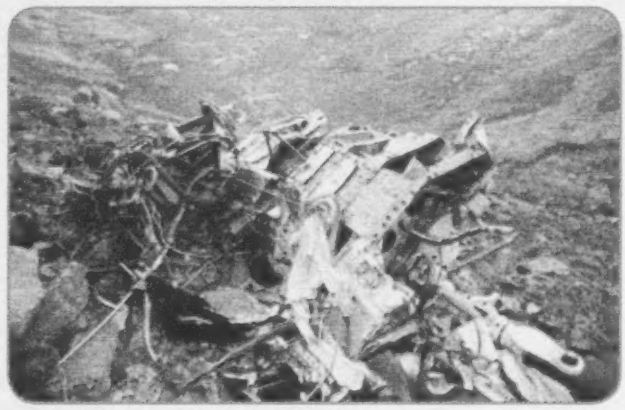
1. Electrical arcing occurred in an engine electrical harness in the area of the oil cooler blower compartment and the aft electrical compartment wall. The exact cause of the wire arcing could not be determined.
2. The initial electrical arcing likely breached a nearby fuel line, which led to the rapid propagation of the fire and the total destruction of the helicopter.

Other findings

1. The pilot's timely decision to terminate the flight and the aircraft's proximity to a suitable landing site facilitated a successful landing.
2. The location of the fire would not initially have produced conditions that would have activated the engine fire caution system.

TSB Final Report A09Q0111—Controlled Flight into Terrain

On July 17, 2009, a float-equipped Bell 206L helicopter was on a VFR flight from Kangirsuk to Kangiqsujuaq, Que. The pilot and an aircraft maintenance engineer were on board the helicopter. Approximately 44 NM from the destination, with reduced visibility and a low ceiling, the aircraft diverted from the direct route and proceeded north towards the shore of the Hudson Strait. The helicopter was flying at a low altitude and at low speed. At a little less than a mile from the coast, the aircraft traversed an arm of the sea in a valley. Within the next minute, at 14:34 EDT, the helicopter in controlled flight struck the north rock wall of the valley. The aircraft was destroyed by impact forces and both occupants were fatally injured. The helicopter was found six days later.



Analysis

The pilot had never flown in Northern Quebec. It was also likely his first experience flying in an area under the influence of an Arctic maritime climate. His practical experience did not enable him to fully appreciate the difficulties to be encountered in flight.

Knowledge of the topography of the Northern Quebec coastline would lead to the conclusion that the multitude of steep-sided arms of the sea makes VFR flight hazardous in reduced visibility. Further, understanding the meteorological characteristics of the region would lead to the realization that the fog in this region is advection fog formed over the ocean that affects the coastal regions. Considering these two elements, a westward diversion should be made to move away from the coast to bypass the areas of reduced visibility.

Before taking off from Kuujjuaq, the pilot obtained weather information to plan the flight. He reviewed the weather information available at the Kuujjuaq flight service station (FSS) and got a verbal description of the weather along the planned flight route from the operator's base in Goose Bay. Based on this information, he delayed the flight about two hours.

The pilot appears to have based his decision to take off from Kuujjuaq essentially on the reported visibility at Kangirsuk and Kangiqsujuaq. The hourly observations at 08:00 EDT, 09:00 EDT, and 10:00 EDT at Kangirsuk and Kangiqsujuaq reported visibility exceeding the minimum visibility required by the CARs to make the flight. In addition, the trend suggested by these

observations gave reason to believe that the weather was gradually improving. Visibility at Kangirsuk had indeed improved from ½ SM to 1½ SM, and at Kangiqsujuaq from 5 to 12 SM. Moreover, the weather at Kuujjuaq was good. Also, the drizzle, fog and low cloud reported at Quaqtaq would not delay the flight to Coral Harbour.

For an undetermined reason, the pilot did not call the flight information centre (FIC) at Québec to request a printout of the graphic area forecast (GFA). Because the pilot could have obtained weather information from the Internet, it cannot be stated without a doubt that he did not check the GFA before going to the airport. However, if he had done so, especially being an airline pilot, he would have easily seen that the GFA for the region called for visibilities of ¼ SM to 2 SM in mist/fog and ceilings of 100 to 200 ft between Kangirsuk and Kangiqsujuaq in the coastal area and over the Hudson Strait. Also, by analyzing the GFA he would have seen that the mist was clearing over the land to the west of the shoreline. Given his qualifications, the route he elected to fly and the diversion route he chose, it is unlikely that the pilot checked the GFA on the Internet.

L
H
Area of mist and fog with visibility 1/4 to 2 miles and ceiling 100 to 400 feet
Kangiqsujuaq
Planned route from Kangirsuk to Kangiqsujuaq
Kangirsuk
Kuujjuaq

This is the GFA available prior to takeoff from Kuujjuaq, Que.

According to the information relayed to the pilot, visibility at Kangirsuk had increased from ½ SM to 15 SM and the ceiling from 200 ft AGL to a few clouds at 600 ft AGL in the previous three hr. Further, the information he received from the Goose Bay base before taking off from Kangirsuk indicated VFR conditions at all the airports where the aircraft was to stop. Consequently, the pilot's decision to continue the flight was reasonable and consistent with his knowledge of the situation.

The GPS data indicate that the flight to Kangiqsujuaq was normal until 44 NM from destination. Because the aircraft was flying at low altitude and high speed, there is reason to believe that the ceiling was low but that visibility was not a hindrance to pilot navigation. However, at that point the helicopter diverted from the direct route and proceeded north towards the coast. By all indications, the pilot diverted due to reduced visibility.

The pilot had three options when he diverted. First, he could land and wait for conditions to improve. Once on the ground, he could call the Goose Bay base to request a weather update and select a better diversion route. Because the weather was not as the pilot had anticipated, and with the benefit of hindsight, that would have been the most reasonable decision. Given the pilot's experience in flying with little or no visibility, it is possible that GPS gave him greater confidence when he encountered poor weather conditions.

Second, the pilot could have diverted west and proceeded farther inland. There is reason to believe that if the pilot had checked the GFA before taking off from Kuujjuaq, he would have chosen that option. The rolling terrain was suitable for low-level flight, and the area of mist/fog was clearing to the west. A thorough analysis of the full weather picture and the planned route would have enabled the pilot to choose that option.

The third option—diverting towards the coast—was the least likely to succeed due to the precipitous coastal terrain and the misty conditions moving inland from Hudson Strait. Because of this, the helicopter headed towards an area where the mist/fog was thickening over terrain that was not suitable for low-level flight. Evidence of this can be seen in the decrease in groundspeed and height of the aircraft above the terrain.

The accident occurred just under 1 NM from the coast while the aircraft was traversing a valley. The GPS data indicate an increase in speed and a loss of altitude after the northbound aircraft flew over the summit of the south wall of the valley. It is possible that the pilot was not aware of his geographical position. If that was the case, he did not know he was about to traverse a valley. The need to maintain visual references therefore led the pilot to follow the downward slope in conditions of reduced visibility. Taking into account his speed, the pilot was unable to avoid the north wall of the valley.

Findings as to causes and contributing factors

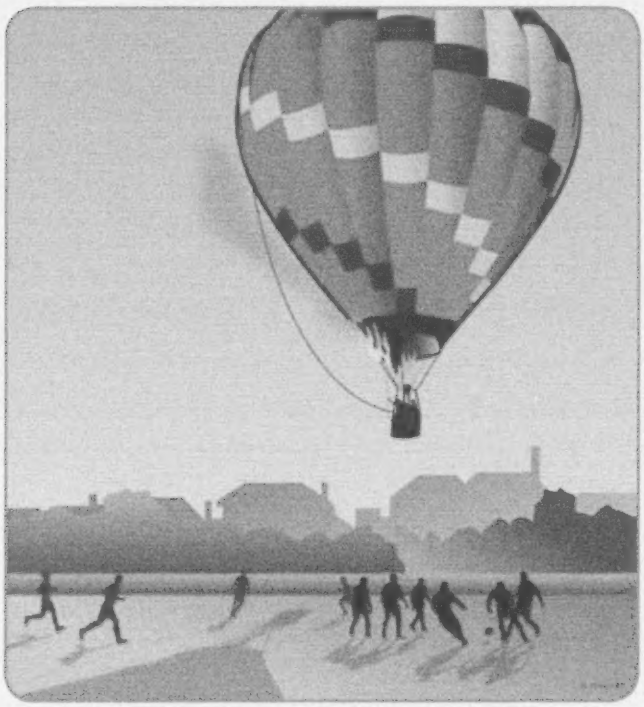
1. The pilot continued the flight in adverse weather in an area where he was unfamiliar with the topography and the associated local weather systems.
2. In reduced visibility, the pilot diverted towards the shore of the Hudson Strait—a location where the weather was deteriorating and where the precipitous terrain was unsuitable for low-altitude flight.

Consequently, the helicopter struck a rock wall in controlled flight in adverse weather.

3. Although not a requirement, specific training on the particular characteristics of this region would have enabled the pilot to fully appreciate the difficulties to be encountered in flight.

TSB Final Report A10O0137—In-Flight Fire and Precautionary Landing

On July 14, 2010, a hot air balloon launched at approximately 19:25 EDT from Carleton University, Ottawa, Ont., for a local flight. On board were the pilot and 12 passengers. While over the city at approximately 700 ft AGL, the balloon encountered turbulence. The pilot initiated a descent with the intention of executing a precautionary landing. The balloon's rate of descent increased unexpectedly, and the pilot had to light all 3 burners to arrest the descent. During this time the lower portion of the balloon's envelope collapsed into the path of the burner flame. Some of the lower envelope panels caught fire, but self-extinguished once the flame was removed. The balloon's basket struck the tops of some trees, and then the balloon climbed to approximately 1 000 ft AGL. The pilot then executed another descent to land. The balloon struck trees during the landing, and subsequently came to rest in a residential area of Ottawa at about 20:00 EDT.



Artist impression of occurrence as the balloon came to land near a soccer field

Findings as to causes and contributing factors

1. The flight encountered localized turbulence that prompted the pilot to initiate a precautionary landing. A high sink rate developed during this initial landing attempt requiring the pilot to use maximum available power to arrest the sink rate.

2. During this descent, the bottom of the balloon envelope came into contact with the burner flame, igniting some of the panels. As the balloon climbed in response to the influx of hot air, the pilot turned the burners off, which allowed the balloon envelope material to self-extinguish.

3. During the second landing attempt, the pilot was concerned about controlling the balloon in the turbulence and the condition of the balloon envelope. This influenced the decision to land in the residential area rather than prolong the flight to a more suitable site.

Findings as to risk

1. Without the same degree of regulatory oversight as other aircraft of equal passenger-carrying capacity, there may not be an equivalent level of safety for balloon operations.

2. The pilot did not define the emergency nature of the precautionary landing to ATS and declined emergency assistance. This could have delayed emergency response.

3. Without adequate information on balloon operations, emergency response units may not take appropriate steps to safeguard passengers, the public and property.

4. With the absence of specific emergency procedures for balloon landings, there is a risk that passengers may be injured because they were not properly prepared for landing.

Other finding

1. The balloon envelope material self-extinguished, as designed, when no longer in the direct influence of the burner flame.

Safety action taken

Transport Canada

As reported on page 33 of ASL **Issue 3/2011**, the article titled "Update on Passenger-Carrying Commercial Balloon Operations in Canada" advised industry that a Civil Aviation Regulation Advisory Council (CARAC) working group was formed at the CARAC Technical Committee meeting of November 2010. The purpose of the "Balloons with Fare-paying Passengers Working Group" is to make recommendations on how to best provide an adequate level of safety to the public involved in sightseeing activities. △

Note: The following accident synopses are Transportation Safety Board of Canada (TSB) Class 5 events, which occurred between May 1, 2011, and July 31, 2011. These occurrences do not meet the criteria of classes 1 through 4, and are recorded by the TSB for possible safety analysis, statistical reporting, or archival purposes. The narratives may have been updated by the TSB since publication. For more information on any individual event, please contact the TSB.

— On May 2, 2011, a Grumman Goose G-21A was on a take-off run at the Owikeno airstrip near Rivers Inlet, about 80 NM northwest of Port Hardy, B.C., when the pilot lost directional control. The aircraft turned 90° to the airstrip and collided with a ditch/embankment. The aircraft nose/bow was damaged. *TSB File A11P0080.*

— On May 5, 2011, a Cessna 172M with four people on board departed from Burlington Airpark (CZBA), Ont., for a local sightseeing flight with a planned duration of approximately 20–30 min. Halfway through the flight, the pilot noticed that the fuel gauges were indicating that the tank was empty and elected to return to CZBA. Approximately 6–7 mi. southeast of the field, the engine stopped and the pilot initiated a forced landing. The aircraft touched down near the end of the selected field. Its right wing struck the trees bordering the field, after which the aircraft spun 180° and came to a rest. The pilot and three passengers were uninjured, but the wings and aircraft empennage were significantly damaged. *TSB File A11O0063.*

— On May 8, 2011, an amateur-built Zenair CH200 was conducting circuits on Runway 09 at the Peterborough airport (CYPQ). The airplane was configured with full flap. The airplane touched down at approximately 70 mph on the main gear, with full flap and carrying some power. It bounced and began to porpoise. Full power was applied to overshoot; as a result, the airplane pitched nose-up. Since the pitch trim control was on the same side as the throttle, the pilot was unable to apply nose-down trim soon enough to prevent the airplane from stalling. Nose-down elevator control was available but was not fully applied. The left wing dropped in the stall, and the airplane struck the ground and came to a stop in the grass about 50 ft off the left side of the runway. The nose landing gear collapsed, and the wing outer panels suffered propeller and impact damage. The pilot was wearing a four-point harness and was uninjured. *TSB File A11O0066.*

— On May 15, 2011, a privately owned, float-equipped Cessna 185 took off on a VFR flight from Sainte-Anne-du-Lac, Que., to Marina Venise, Que., with three people on board. At approximately 10 NM north of the Mirabel airport, the engine (Continental IO-520-D) stopped at 1 500 ft ASL. In the moments that followed, the aircraft started to spin. The pilot was able to come out of the spin and conducted a forced landed. Upon landing, the aircraft struck a camper before stopping on its back. The occupants sustained minor injuries. When the engine was subsequently inspected, water was found in the gas pump. *TSB File A11Q0093.*

— On May 16, 2011, an Aerospatiale AS350 BA helicopter was bucketing water to support firefighting operations near Meadow Lake, Sask. The winds were gusting from the southeast at 20-30 kt. The pilot was flying slowly just above treetop level to dump a load of water on a fire break area when the nose of the helicopter suddenly swung to the left. The pilot increased power, but the rotation also increased. The pilot reduced power and lowered the collective. The helicopter entered the trees and came to rest on its right side; the tail boom separated from the helicopter. The pilot was transported to the Meadow Lake Hospital and kept overnight for observation. *TSB File A11C0076.*

— On May 23, 2011, a Bell 206B helicopter was conducting slinging operations at an oil field well site approximately 50 NM east of Slave Lake, Alta. The slung load conflicted with structures at the well site and the helicopter collided with the ground. The pilot, who was the sole occupant, sustained serious injuries. Two TSB investigators from the Edmonton office were deployed to the site. *TSB File A11W0069.*

— On May 23, 2011, a Bell 206B helicopter was on a VFR flight from Lake Berthelot, Que., to Mirabel, Que., when it crashed in a forest approximately 20 NM northwest of l'Ascension, Que. Both occupants were seriously injured and were evacuated by land. The emergency locator transmitter (ELT) went off following the crash. Foggy conditions were prevalent in the region at the time of the accident. *TSB File A11Q0099.*

— On May 29, 2011, a Bell 206B helicopter was conducting a low-level pipeline survey 5 NM east of Loon River, Alta., when the aircraft struck an unmarked wire conduit. The pilot was able to conduct an emergency landing near the site. The main rotor blades were significantly damaged. The pilot and passenger were uninjured. *TSB File A11W0076.*

— On June 3, 2011, a privately registered Cessna 180 was attempting to take off from the water at Bedwell Harbour, B.C. (CAB3). The pilot reported that

the aircraft yawed dramatically, which caused one wing to strike the water and consequently flipped the aircraft over into the water. The pilot and the only other occupant had read and used Transport Canada's (TC) seaplane safety literature to complete their preflight briefing. They were both able to escape with little or no injury; however, they were not wearing personal floatation devices (PFDs) and were unable to retrieve any before exiting the aircraft. They were rescued quickly by nearby boaters. *TSB File A11P0093.*

— On June 5, 2011, an Ecureuil AS 350 BA helicopter was on a flight to study aquatic fauna (water fowl). While the aircraft was flying at 30 kt at an altitude of 20 ft, a noise was heard, followed by vibrations. The pilot noticed that the speed of the Ariel 1B engine's gas generator (Ng) had fluctuated. While the pilot was guiding the helicopter towards the shore for a precautionary landing, the aircraft experienced a total loss of power. The aircraft struck the surface of the water hard and came to rest on its left side, half submerged. The three occupants were able to egress and head to the shore. They sustained minor injuries and were rescued by another of the operator's helicopters. The aircraft was equipped with a 406 MHz emergency locator transmitter (ELT). The Joint Rescue Coordination Centre (JRCC) received a signal indicating that the transmitter had gone off without any information as to the location of the transmitter. The engine will be checked by an expert under the supervision of a TSB investigator. *TSB File A11Q0102.*

— On June 8, 2011, a privately operated, float-equipped Cessna 180E was departing for a VFR flight from Balsam Lake, Ont. Shortly after it became airborne, the airplane descended, struck the water, and came to rest inverted. At the time, a severe thunderstorm was rapidly approaching, and it reportedly caused sudden strong and gusty wind conditions and white caps on the water. The pilot, who was the sole occupant of the airplane, did not exit the aircraft and suffered fatal injuries. The airplane was substantially damaged. TSB investigators were deployed to the scene. *TSB File A11O0085.*

— On June 24, 2011, a Robinson Raven II helicopter was on a ferry flight from Québec (CYQB) to Lake Deborah, approximately 50 NM north of Schefferville (CYKL). Upon arrival, the pilot conducted a 360° turn over the landing area, which consisted of logs, over which the skids had to be placed perpendicularly. Once the circuit was completed, the aircraft descended and appeared to skid to the left. It started turning right, continued to descend, and crashed approximately 350 ft northwest of the landing area on land where a few trees grew. The passenger was killed and the pilot sustained serious but non-life threatening injuries. *TSB File A11Q0115.*

— On June 27, 2011, a Canadian-registered Hughes 500D helicopter landed on a mountaintop helipad 65 NM east of Ambler, Alaska. Shortly after the aircraft landed, the four passengers exited and walked away while the pilot kept the helicopter running to cool down the engine. The pilot then exited the helicopter to look under it and verify that the landing skids' bear paws were both securely placed on the supporting timber. The helicopter slipped and tipped backwards until it came to rest on the tail stinger. The tail rotor struck the ground, one of its blades came off, and the tail rotor stopped turning. The engine was still driving the main rotor. The pilot reached into the cockpit and shut down the helicopter. There were no injuries, but the helicopter was substantially damaged. *TSB File A11F0132.*

— On June 27, 2011, a float-equipped Cessna 185 was landing at Theriau Lake, Sask., with the pilot and one passenger on board. Shortly after touchdown, the aircraft veered to the left and then overturned. The pilot, who was wearing a shoulder harness, and the passenger, who was wearing a seat belt, were able to egress from the aircraft. With the help of personal floatation devices (PFDs), they swam to shore, where they lit a fire and spent the night. When the aircraft did not arrive at its destination, company personnel advised dispatch that the aircraft was overdue. Due to darkness, a search for the aircraft began the next morning. The pilot and passenger were found early the next morning and transported to Points North Landing, Sask. Both the pilot and passenger sustained minor injuries and the aircraft was substantially damaged. It was reported that the bottom skin of the left float exhibited a large rectangular tear consistent with collision with a submerged log. *TSB File A11C0099.*

— On July 1, 2011, a de Havilland DHC2 Beaver was departing from Lake Lillabelle, Ont., for Stringer Lake, Ont. Approximately 3 NM north of the departure point, the engine (Pratt & Whitney R-985) started to make unusual clacking sounds, which were quickly followed by a complete failure. The pilot completed a forced landing in the most suitable spot, which was a swampy area near a small stream. Upon touchdown, the aircraft's floats struck several obstacles that were on or just beneath the surface of the water, causing extensive damage to the floats and float struts. The aircraft came to rest with one wing and part of the empennage in the water. The pilot and occupants were uninjured. *TSB File A11O0106.*

— On July 1, 2011, a float-equipped Champion 7AC was on a VFR flight from Rivière Metabetchouan, Que., to Lake La Bouille, Que. The sky was clear upon departure, and the weather for the day was expected to be VFR. The trip was to take approximately 3 h 45 min. At about 45 min from destination, there was morning fog over the lakes, which became extended over land. The pilot decided

to land on a lake to wait for the morning fog to dissipate. While the pilot was descending towards the lake and manoeuvring in fog to land, the aircraft struck the trees and flipped over. The pilot sustained minor injuries. The passenger was not hurt. The occupants retrieved the survival equipment and confirmed that the 406 ELT was on. SAR located and evacuated the occupants approximately 4 h after the occurrence. The aircraft was substantially damaged. *TSB File A11Q0120.*

— On July 3, 2011, a privately operated Robinson R44 II helicopter was on approach to land near Carievale, Sask., when the helicopter collided with a power line. The pilot conducted a precautionary landing and determined that the rotor system had sustained substantial damage. The pilot was not injured. *TSB File A11C0107.*

— On July 4, 2011, a Robinson R44 helicopter was on a VFR flight en route from Baie Comeau, Que., to Havre St-Pierre (CYGV), Que. The weather deteriorated to instrument meteorological conditions (IMC) and the pilot declared an emergency due to a low fuel situation. The aircraft was directed to a location near CYGV and above the St. Lawrence River. The pilot chose to descend in cloud and quickly lost control of the helicopter. Mast bumping occurred. VFR was regained a few hundred feet above the water, 1 NM from CYGV. The pilot landed normally at CYGV. Damage to the main rotor head was visible after the aircraft was inspected. *TSB File A11Q0126.*

— On July 4, 2011, a Cessna 305 flew from Hawkesbury, Ont. (CNV4), to St-André d'Avellin, Que., to retrieve a glider that had landed at the abandoned airfield there earlier in the day. Permission to land and retrieve the glider from the present owner of the abandoned airfield was obtained prior to departure. Upon landing on the asphalt surface, the aircraft ground-looped. As a result, the left wing touched the ground, the propeller was damaged and the left main gear collapsed. The pilot was not injured. *TSB File A11Q0123.*

— On July 5, 2011, an Ayres S-2R was applying fungicide to a field when the aircraft collided with a tower guy wire. The aircraft came to rest upright and the pilot exited with minor injuries. The collision and post-impact fire destroyed the aircraft. *TSB File A11C0105.*

— On July 10, 2011, a privately registered, float-equipped Cessna U206F was flying from Dorothy Lake, Man., to Lac du Bonnet, Man., for fuel. All the aircraft's fuel was in the right tank and the fuel selector was set to "right". While the pilot was completing a right turn after takeoff, the engine lost power. The pilot completed a forced landing in a wooded area. The aircraft sustained substantial damage, but the pilot was not injured. *TSB File A11C0110.*

— On July 28, 2011, an amphibious de Havilland DHC-3T (turbine) was landing at Kabania Lake, Ont., after taking off from Pickle Lake, Ont. The landing gear remained extended during the flight after the aircraft departed from the Pickle Lake airport. Upon touchdown, the aircraft nosed down and overturned. Both crew members were wearing four-point harnesses and were not injured. They exited the aircraft and were picked up by boat by personnel from a nearby outpost camp. The aircraft sustained substantial damage. *TSB File A11C0124.*

— On July 28, 2011, an advanced ultralight Norman Aviation J6 Kanatoo was conducting touch-and-gos on a runway in the Lake De Montigny, Que., region. During the initial climb, a gust of wind pushed the aircraft towards the lake, and the pilot was not able to regain control of it in time. The aircraft crashed in the lake. There were no injuries, and the aircraft was significantly damaged. *TSB File A11Q0143.*

— On July 28, 2011, an advanced ultralight Titan Tornado II was on a VFR flight in the Sainte-Marie-Madeleine, Que., region. During the initial climb, the Rotax 503 engine lost power at approximately 200 ft AGL. The pilot attempted to land on the runway, but he chose to overrun the runway on the right side given the high speed of the aircraft and the presence of a road. The pilot, who was the only person aboard the aircraft, was not injured, and the aircraft was significantly damaged. *TSB File A11Q0145.* △

THINK WINTER FLYING!

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How an Everyday Event can Turn into a Dangerous one

by Gavin Wyllie, Advisory and Appeals Officer, Policy and Regulatory Services, Civil Aviation, Transport Canada

In this issue, the Advisory and Appeals Division wishes to share a case with our readers illustrating the importance of cooperation between pilots flying in the same vicinity, particularly at an uncontrolled airport without air traffic control. As usual, the names of the people involved have been omitted; our goal is simply to be educational.

The case is a recent decision from the Transportation Appeal Tribunal of Canada (TATC). In the case, the TATC stated that safety in aviation is everybody's responsibility. The TATC further stated that everyone flying into, working at, and providing services at an uncontrolled airport bears this responsibility.

The facts centred on a daytime incident at a rural airport in Ont., which was serviced by radio through flight service station (FSS) specialists. These specialists were located in a town remote from the rural airport. A Learjet from the USA had been cleared by Toronto air traffic control for a runway northbound approach from the south at the rural airport north of Toronto. At the same time, a Cessna (Cessna 1) was flying in the circuit at the rural airport with a flying instructor and student at the controls. Following Cessna 1 in the circuit was another Cessna (Cessna 2) with the owner-passenger and his instructor on board. According to the testimony of the owner of Cessna 2, Cessna 1 turned towards the north end of the runway with a relatively steep angle of descent, instead of turning base. Cessna 2 stayed high and extended its downwind and base legs and eventually left the area.

The owner of Cessna 2 provided evidence that Cessna 1 had placed himself in a head-on situation with the Learjet. Cessna 2 was astounded by the bold actions of Cessna 1 in placing itself on a collision course with the Learjet in what appeared to be an "I'm here first" attitude.

One of the specialists at the remote location had asked Cessna 1 by radio to do a missed approach but received no response. According to the compelling testimony of the co-pilot of the Learjet, at the last moment, Cessna 1 pulled up sharply and passed directly over the Learjet at an estimated 50 ft. The Learjet was on its rollout. The co-pilot of the Learjet had heard a specialist asking Cessna 1 to break off its approach to accommodate the incoming jet. The co-pilot also added that it would have been too dangerous for the Learjet to have done a missed approach as an avoidance manoeuvre.

The Tribunal Member weighed the testimony of the three eyewitnesses who were pilots: the Learjet co-pilot and the two pilots in Cessna 2. These witnesses all placed Cessna 1 about 50 ft above the Learjet on the active runway and provided evidence that there had been a risk of collision due to proximity attributable to Cessna 1. The two witnesses for the Cessna 1 owner included an airport employee and the student pilot aboard Cessna 1. The TATC determined that the airport employee did not see the crucial part of the incident, as Cessna 1 overflew the Lear. The student pilot testified that he never descended below 600 ft AGL and that he climbed to a point half a mile west of the runway at the critical time. This version of the events was not accepted by the TATC, which found the student pilot to have little credibility and did not accept his version of the events because it was the only one quite different to every other witness of the event.

The flight instructor and his student in Cessna 1, doing the abrupt short final making a beeline for the north end of the runway, were found by the TATC to have intentionally flown in close proximity to the Learjet and were found to have created a risk of collision. Evidence was given that the pilot had informed one of the specialists that Cessna 1, which was already in the circuit, was not being considered by the incoming Learjet. The TATC found that everyone did their best to fly safely except the flight instructor in Cessna 1, who had some 20 000 hr of flying time and had to bear responsibility for this event.

A monetary penalty of $5,000, for the contravention of section 602.12 of the *Canadian Aviation Regulations* (CARs), was assessed by the Minister of Transport (Minister). Section 602.12 of the CARs prohibits a person from operating an aircraft in such proximity to another aircraft as to create a risk of collision. The penalty assessed by the Minister was upheld by the Tribunal. It should be noted that the rural airport was the home base of operations for the Cessna 1 instructor's flying school.

In conclusion, there is clearly no room for the pilot to position his aircraft in direct conflict with another

aircraft during a landing when a missed approach or an extended downwind leg to accommodate would have been a reasonable response to the situation. The "statement" or action by Cessna 1, the slower-moving local aircraft, was inappropriate, violated aviation safety standards and warranted the penalty assessed by the Minister. △

Updates on TAWS and EWH to prevent CFIT!

Here is a quick update on Terrain Avoidance Warning Systems (TAWS), and eye-to-wheel height (EWH) information, and the crucial roles these play in controlled flight into terrain (CFIT) prevention.

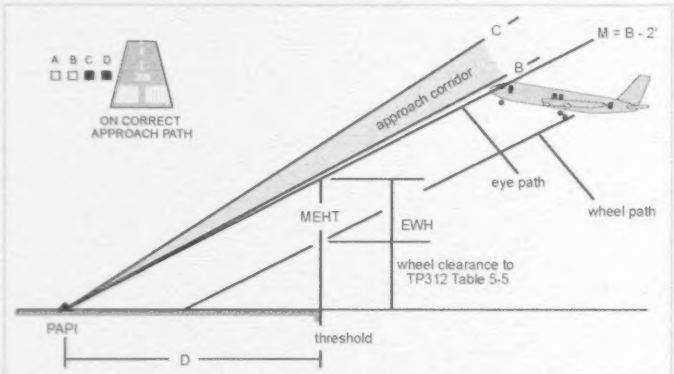
Advisory Circular 600-003 on TAWS

TAWS stands for Terrain Awareness Warning System. This equipment provides aural and visual alerts (both cautions and warnings) to flight crew when the path of the aircraft is predicted to collide with terrain (in some systems, also with obstacles), and this allows flight crews sufficient time to take action.

Transport Canada Civil Aviation (TCCA) is proposing regulations that require the installation and operation of TAWS for Commercial Air Taxi, Commuter and Airline Operations (Subparts 703, 704 and 705 of the *Canadian Aviation Regulations* [CARs]) and Private Operators (Subpart 604 of the CARs) to prevent controlled flight into terrain (CFIT) accidents. TCCA recently issued Advisory Circular (AC) #600-003, to update industry on the current status and implementation dates of the TAWS regulations. Read the complete AC at www.tc.gc.ca/media/documents/ca-opssvs/ac-600-003.pdf.

TC AIM update on approach slope indicator systems, specifically on eye-to-wheel height (EWH) information

The October 2011 issue of the TC AIM included a significant update of Section AGA 7.6—Approach Slope Indicator Systems; specifically, detailed information on EWH information has been added. Readers will recall that EWH was a significant issue in the accident involving a Canadair Global 5000 at Fox Harbor, N.S., on November 11, 2007 (TSB File A07A0134, which was summarized in ASL Issue 1/2011). Take a few minutes to read AIM Section AGA 7.6 at www.tc.gc.ca/eng/civilaviation/publications/tp14371-aga-7-0-3097.htm#7-6. △



Worth Watching—Again! Black-holes and Little Grey Cells—Spatial Disorientation During NVFR

This excellent aviation safety video was produced in 2000, and it addresses Night Visual Flight Rules (NVFR), black-hole illusion, somatogravic illusion and other traps and challenges facing pilots flying VFR at night. The video also contains some recommended procedures and practices that will assist pilots in making their night VFR flights as safe as possible. It has been available on the Transport Canada Web site in streaming video format for many years now at www.tc.gc.ca/eng/civilaviation/publications/TP13838-5810.htm. Take a few minutes to watch it, and if you have already seen it, then, watch it again! Time well spent!

Too Heavy: Helicopters Should Not Operate at OGE Hover Limitations

Helicopters have been operating too close to the limits for years, and a dissenting point of view has long been wanting. The circumstances under which a helicopter will operate only in ground effect (IGE) are rare. It may happen with scheduled operations when the helicopter is operating from helipad to helipad using paved or concrete surfaces over which ideal IGE hovering conditions are achieved. For those machines operating under just about any other circumstances, out of ground effect (OGE) operations are the rule rather than the exception.

I will use the performance of a common single-engine turbine helicopter as an example. The charts for the OGE hover ceiling for this type, as with any other type of helicopter, are published in its flight manual. These ceilings are predicated on density altitude (DA) in otherwise standard atmospheric conditions in which the humidity is zero percent[1]. If the pilot is operating at those limits, any attempt to manoeuvre with any application of power, engine and/or transmission limits will likely be exceeded. If operations under these conditions are to be practically and safely carried out, in my opinion gross weight should be less than the maximum specified by the OGE hover ceiling charts to allow the pilot a margin of power for manoeuverability.

To validate my point, I calculated the length of time required to vertically climb 100 ft at specific weights and using the power required to hover OGE. (My calculations were derived by considering the difference between the weight of the helicopter and the thrust required to maintain an OGE hover.) My calculations showed that when operating as close to 50 ft below the OGE limits, it can take up to 20 sec to vertically climb 100 ft. It is reasonable to characterize this sort of performance as sluggish at best, and perhaps dangerous at worst. By reducing the gross weight to 100 lbs less than the OGE hover ceiling weight, I found that the situation improves considerably, and when it is reduced by 200 lbs, the time required to climb 100 ft is half that of a 50-pound reduction. Therefore, the advantages of operating at 200 lbs below the OGE hover ceiling when conducting OGE operations are several:

- the helicopter is subject to reduced power demands;
- pilot work load is reduced;
- the time spent in the shaded area of the height-velocity diagram is reduced;
- the effects of humidity on density altitude and OGE operations are to some extent mitigated;
- the critical relative wind azimuth area on the OGE hover ceiling chart will almost certainly be avoided;
- the pilot's power margin is greater and manoeuverability is enhanced; and
- some admittedly small savings in flying time may be achieved in some cases.

Operational helicopter flying involves landings on ridges, pinnacles or helipads constructed on mountain sides or man-made structures, which almost always results in OGE situations. The modern approach to safety is a proactive one and standard practices are designed to reduce the probability of an occurrence. As I attempted to illustrate in my example, gross weights should be reduced by up to 200 lbs below the OGE hover ceiling limits for all but the most mundane of operations.

Fred Lewis
Medicine Hat, Alta.

1 Humidity decreases air density and therefore decreases OGE hover ceilings. At 6 000 ft pressure altitude on a 20° C day with 0% humidity, the density altitude is a bit over 8 000 ft. Under the same conditions and 100% humidity, the DA is almost 8 300 ft, resulting in an OGE hover ceiling weight reduction of about 50 lbs.

Effective Pilot/Controller Communications

The following is adapted from an operator's internal Company Safety Bulletin distributed to all its pilots. The content is applicable to all and is promoted in the ASL with the operator's permission.

Pilot/controller communication errors were a contributing factor in a number of recent occurrences we investigated. These errors have resulted in altitude deviations, TCAS resolutions, ground conflicts, runway incursions and clearance deviations. In one recent case, a crew dropped the company name from their identifier and read back the number only. This might seem like a small mistake, but in this case, the abbreviated call-sign contributed to a ground conflict.

Communication issues between pilots and controllers have been a contributing factor in many incidents globally. Here is a succinct definition of pilot/controller communications from the British CAA's *Radiotelephony Manual* (CAP 413):

> Radiotelephony provides the means by which pilots and ground personnel communicate with each other. Used properly, the information and instructions transmitted are of vital importance in assisting in the safe and expeditious operation of aircraft. However, the use of non-standard procedures and phraseology can cause misunderstanding. Incidents and accidents have occurred in which a contributing factor has been the misunderstanding caused by the use of non-standard phraseology. The importance of using correct and precise standard phraseology cannot be over-emphasized.

The following information was selected from the Human Performance Flight Operations briefing note on Effective Pilot/Controller Communications developed by Airbus and the Flight Safety Foundation.

The pilot/controller communication loop

The pilot/controller communication loop constitutes a confirmation/correction process that ensures the integrity of communications. Strict adherence to this closed loop constitutes a line of defence against communication errors. Readback/Hearback errors may result in an event such as: operational deviation; airborne conflict; less than required separation; runway incursion; near midair-collision, etc.

Effective communication is achieved when our mental process is able to accommodate and to interpret the information contained in a message. This mental process can be summarized as follows:

- How do we perceive the message?
- How do we reconstruct the information contained in the message?
- How do we link this information to an objective or to an expectation?
- What bias or error is introduced in this process?

Crew resource management (CRM) research highlights the relevance of the context and expectations in this process. Nevertheless, expectations may introduce either a positive or negative bias in the effectiveness of the communication. Workload, fatigue, non-adherence to the sterile cockpit rule, distractions, interruptions, conflicts and pressure are among the factors that may affect adversely pilot/controller communications.

Key points for effective pilot/controller communications

- Company SOPs are adhered to.
- Respective working environments and constraints are understood.
- Use of standard phraseology is disciplined.
- The pilot/controller communication loop is adhered to.
- There is an alertness to request clarification or confirmation, when in doubt. △

TAKE FIVE...

for safety

Five minutes reading could save a life

FORMATION FLIGHT

The risk

As pilots, we are in the business of managing and mitigating risks. Formation flying adds a new set of hazards to a flight by taking the decision-making ability away from the individual pilot and putting it in the hands of the lead aircraft. The lead aircraft, in turn, has to navigate, communicate, and think for the group, all while having to operate the aircraft with consideration to others in the formation. Military pilots and precision aerobatic teams mitigate this risk though specialized training, years of experience, and strict standard operating procedures (SOP).

How will you reduce the risks associated with formation flight?

The regulations

There are two *Canadian Aviation Regulations* (CARs) that apply to formation flight other than at an air show:

> **602.21** No person shall operate an aircraft in such proximity to another aircraft as to create a risk of collision.
>
> **602.24** No person shall operate an aircraft in formation with other aircraft except by pre-arrangement between
>
> *(a)* the pilots-in-command of the aircraft; or
>
> *(b)* where the flight is conducted within a control zone, the pilots-in-command and the appropriate air traffic control unit.

Pre-flight briefings should be considered an essential part of the requirement to pre-arrange a formation flight.

Before the flight, ask yourself a few questions…

- **Did the briefing cover how the flight is to be conducted in both normal and emergency situations?**
- **What is your role in the event of an emergency?**
- **Are your formation skills good enough that you won't pose a risk of collision? How do you know?**
- **Is the pilot on your wing good enough? How do you know?**

If you have trouble answering these questions consider postponing the flight until you can.

Other factors and information:

- Check with your insurance provider, not all insurance companies cover formation flight.
- The *Aeronautical Information Manual* (TC AIM) RAC 12.13 describes formation flight procedures with reference to air traffic control and flight planning.

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